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Preliminary surveys and borings are being made at Port Huron, Mich., for a canal to connect Lake Huron with the Black River and flush the latter. Black River is a sluggish stream flowing through the center of the city of Port Huron and into the St. Clair River, about two miles south of Lake Huron and below the rapids. This stream has been used for the outlet of the principal sewers of Port Huron. It has a pulp factory on its banks, just above the city, which discharges large quantities of sulphuric acid into its contaminated waters. The action of the acid on the organic matter in the river produces, it is said, an odor which is very offensive; hence the demand for some means of purifying Black River. The proposed canal has always been considered the most feasible means of effecting this, as the surface of Lake Huron during the dry summer months has an elevation of 1 3-10 ft. above this river, and is only 6,700 ft. distant. The average elevation of the surface above Lake Huron along the line of the proposed canal is 20 ft., the greatest height being 31 ft. The soil is sand, muck and clay. The surveys are being made by Mr. F. F. Rogers, City Engineer.

The Manchester ship canal, according to the report handed in at the last half-yearly meeting of its stockholders, has, in the first six months of its operation, earned $221,540 from all sources on a capital account of $77,000,000. These are gross earnings, not net, and are at the rate of about .058% on this capital for one year. The actual expenditure of capital to date is a little less than the capital powers, or $73,247,050. The report divides these expenditures up to June 30, 1894, as follows: Construction of works, including plant, $48,876,510; the Bridgewater Canal purchase, $8,925,710; land purchase and compensation, $6,364,820; engineering and surveying, $701,350; interest on share and loan capital, $5,853,670; Parliamentary expenses, $827,910; general expenses, $1,897,080. In the half-year dealt with in the report, the traffic amounted to 281,000 tons of sea-going freight and 109,000 tons of barge freight.

The Panama Canal promoters propose to start again with an issue of $15,000,000 in new shares, of which $1,000,000 is to be given to Colombia for prolonging the concession. By legal process, says the Paris despatch, the Canal liquidator has compelled contractors and others convicted of fraudulent dealings with the old Canal Company to take up $8,000,000 of the new issue. The directors of the new company are said to include representatives of the Credit Lyonnais, Credit Industriel and the Societe Generale. The first question to be considered, however, is the amount of work on this canal that can be done for $10,000,000; and the second is, where the necessary further millions will come from.

Plans involving the extension of piers and bulkheads along the Delaware River front, in Philadelphia, have been prepared by Mr. Webster, Chief of the Bureau of Highways, and these are now before the City Councils. A continuous stone or concrete bulkhead, along the river front, is contemplated, and all sewer outlets would be extended so as to discharge into the current, instead of into docks as at present. The estimated cost of the improvement is about $1,500,000.

One of the largest, if not the largest, steel plate ever rolled was successfully turned out of the mills of the Wellman Iron & Steel Co., at Chester, Pa., on Sept. 6. The ingot of open-hearth steel used weighed 21,000 lbs.; and this was rolled into a plate 37½ ft. long by 10 ft. 10 ins. wide and 1¼ ins. thick. The finished plate, when sheared, will be 35 ft. 7 ins. long by 10 ft. wide.

A tunnel at Cincinnati is proposed by the Dayton & Cincinnati Terminal Co., in connection with some new tracks in the "old Deer Creek valley." It is reported that the tunnel would be a mile long and that an ordinance granting the company power to make the improvement will be introduced in the Board of Administration. Mr. Robert G. Ingersoll is said to be the president of the company.

The construction of four miles of boulevard at Newton, Mass., was authorized a few days ago, and $100,000 was appropriated for the purpose. It is proposed to make a street 120 ft. wide, with space for an electric railway in the center. A total length of seven miles of boulevard is projected and by means of it connection will be made with the boulevard and park systems of Boston and suburbs now executed or proposed. It is said that the cost of the boulevard will be assessed upon property benefited.

A road improvement convention has been called to meet at Columbia, Mo., Oct. 17, 18 and 19. The Missouri Roads Improvement Association, the State Board of Agriculture and the State University will lend their aid to the success of the convention. Road machinery companies have signified their intention of making exhibits, and a large collection is expected of graders, excavators, rock crushers, steam and horse-power rollers, and other road-making machinery, which will be in operation. Gen. Roy Stone, of the Road Inquiry Office, Washington, D. C., will attend the convention. The secretary is Mr. Lee Chubbuck, of Kidder, Mo.

The most serious railway accident of the week was a rear collision of freight trains in the Hoosac Tunnel, Fitchburg R. R., Sept. 8. An eastbound freight train had broken down in the tunnel, but the operator at the east end showed a white light to a following train without waiting until notified by the operator at the other end that the first train had passed out. The smoke and steam from a westbound train prevented the tail lights of the standing train being seen. The caboose and several cars were wrecked. Two men were killed and two seriously injured. The cause of the accident appears to have been similar to that of the accident on the West Jersey Ry., reported last week. ——A fast train on the Wabash R. R. ran into some loaded coal cars near Staunton, Ill., Sept. 7, and the engine, baggage car, mail car and combination car were wrecked. Three men were killed.——A similar accident to this last occurred Sept. 9 near Barrington, Ill., on the Chicago & Northwestern Ry., in which one man was killed and five were seriously injured.——Ten coal cars broke away from a train near Columbus, O., Sept. 3, and ran back down grade to the bridge over the Olentangy River, where they collided with a Baltimore & Ohio R. R. express. The engine, tender and baggage car were thrown off the bridge. One man was killed and five persons were injured.

An express train from Paris to Cologne ran into a freight train which was being switched at Apilly, Sept. 9, and several cars were telescoped and smashed. About 10 persons were reported killed and 20 injured.

The sub-committee of the Citizens' Committee on track elevation in Chicago, appointed to investigate the progress of work on the elevation of the tracks of the Chicago, Rock Island & Pacific and Lake Shore & Michigan Southern railways (Eng. News, April 26, 1894), presented its report Sept. 8. This report stated that work was progressing on the foundations for the elevated structure, 1,118 men being at work, and that plans were being prepared to carry the whole construction rapidly along. The report also stated that the committee had learned incidentally, though not officially, that the Pittsburg, Ft. Wayne & Chicago R. R. was likely in the near future to enter upon the work of elevating its tracks, providing it could receive as satisfactory treatment as had been accorded to the two above-named companies.

An ordinance providing for the elevation of the tracks of the St. Charles Air Line Ry., in Chicago, will be presented to the City Councils at their meeting on Sept. 24. This road is operated jointly by the Illinois Central, Michigan Central, Chicago, Burlington & Quincy and Chicago & Northwestern railways, and runs west from near Michigan Ave., on a line just north of 16th St. to near Lincoln St., crossing Wabash Ave., State St. and other main north and south streets, and also the line of the "Alley L."' or Chicago & South Side Rapid Transit Co.'s elevated railway. As the tracks of the St. Charles Air Line are crossed by several of the railways entering the city from the south, in addition to the crossing of the elevated road, the construction of an ordinance satisfactory to all parties is a work of some difficulty. No details of the ordinance have yet been made public.

Another Niagara power development company has reached the stage where proposals for actual construction are invited. As shown by the advertisement to contractors in another column, the work consists of a canal excavation about 7½ miles in length and involving the excavation of about 1,300,000 cu. yds. of earth and 4,300,000 cu. yds. of limestone rock. An average rate of work of 16,000 cu. yds. of excavation daily is to be required of the contractors, at which rate about a year would be required to complete excavation.

A report on a proposal to instal an artesian water supply for Providence, R. I., has just been made to the city council by Mr. J. Herbert Shedd, M. Am. Soc. C. E., City Engineer. The report was made in connection with a recent proposition of the National Artesian Well Co. to sink wells with a daily capacity of 15,000,000 gallons on the city's property at the Pettaconset pumping station. Mr. Shedd states that the average amount of rainfall percolating into the ground in New England may be taken as 6 ins. At this rate about 53 sq. miles of drainage area would be required to yield 15,000,000 gallons per day, assuming that the whole 6 ins. could be secured. Mr. Shedd judges that at most 1,000,000 gallons of water per day could be secured from the area which would be tributary to the land in which it is proposed to sink the wells, which would leave 14,000,000 gallons to be secured from percolation from the Pettaconset River, which he does not believe could be relied upon. In short, he advises, after reviewing the local situation, including the quantity and character of the yield from wells already sunk in Providence, and after considering the experience at other places, that time or money spent in seeking an underground supply at the pumping station would be wasted, unless a very small supply were all that was required.

The dangers of grade crossings of electric and steam railway tracks have often been noted in these columns, and it is interesting to hear of a case in which the two companies concerned have arranged for an overhead crossing. The Citizens' Traction Co., of Sharpsburg, Pa., got permission from the courts to cross at grade the tracks of the Pennsylvania R. R. near Guyasuta station, in spite of the opposition of the latter road. As the road crossing is a dangerous one the complication of a track crossing was still strongly objected to, and after a number of conferences between the officials of the two companies arrangements were ultimately made satisfactory to both parties for crossing overhead, 60 ft. west of the present crossing, so as to get rid of the grade crossing entirely, which will be quite a relief to both railway companies. The bridge will be iron, with a span 100 ft. long, crossing the tracks at an angle of 43° 14', with a clearance of 20 ft. above rails. The roadway will be 21 ft. wide, including two sidewalks 2 ft. 6 ins. each. The grade on the east approach will be 3% with a curve 70 ft. radius. On the west approach the grade will be 8% with a curve 400 ft. radius at the foot. The track across the bridge will be on a tangent. The heavy grade on the west approach was necessitated in order not to interfere with the grade on Main St., in Sharpsburg. The entire cost of this improvement is estimated at $12,000, a certain portion of which will be paid by the Pennsylvania R. R.

The pumping capacity of the Chicago water-works system is to be increased by the purchase of new pumps with an aggregate daily capacity of 92,000,000 gallons. Bids for furnishing these pumps will be called for at once. There will be five new pumps in all, three of 14,000,000 gallons capacity each at the Lake View station, Sixty-eighth St. station and Fourteenth St. station, and two of 25,000,000 gallons each at the Chicago Ave. station. The total cost of the work is estimated at $495,000. We expect to give full details of the proposed work in our next issue.

TIE AND TIMBER PRESERVING WORKS AT LAS VEGAS, N. M.; A., T. & S. F. RY.

By F. Meredith Jones.

In the early days of railway building in the treeless districts of the great plains, timber for ties and bridges was brought forward from the rear, furnished by the wooded slopes of the tributaries of the Mississippi River. Later, upon reaching the foothills of the Rocky Mountains, large stores of fair lumber were found and freely appropriated from the unoccupied sections of the public domain. It soon became evident, however, that the mountain timber had a very short life, even in the dry climate of the arid regions. Renewals of ties began before the expiration of the second year, and three years came to be considered about the average life of the tie. So much renewing not only made an expensive track to maintain, but an uneven, unstable and dangerous one, for the reason that the roadbed never became thoroughly settled.

Some practical plan of lengthening the life of the timber early engaged the attention of the officials of the Atchison, Topeka & Santa Fe Ry., and it is probably due to the efforts of Mr. A. A. Robinson, then Chief Engineer and now General Manager, that a plant was established in Las Vegas, N. M., in 1885, under the immediate supervision of Mr. S. M. Rowe, M. Am. Soc. C. E, for the chemical treatment of ties and other timber.

The plan and view given herewith show quite well the general arrangement of the works, which are not dissimilar to the works at Houston, Tex., described in Engineering News of April 26, 1894. There are two cylinders, 6 ft. inside diameter and 106 ft. long, opening at one end only. A narrow-gage track is laid in the yards and within the cylinders, and the iron cylinder cars are propelled both in and out by a duplex hoisting engine and wire cable. Storage and mixing tanks, storehouses, etc., are provided.

A very large percentage of the timber treated consists of hewn ties of the native or mountain timber. They are unloaded from the cars at the spotter onto an endless platform, which carries them through the saws, where the ends are sawed off and the faces scarfed to give the rails an even bearing. As the ties drop from the endless platform they are loaded onto cylinder cars and passed along to the cylinders, where the treatment is given, requiring about ten hours. They are then drawn onto the elevated platform, where they are loaded into railway cars for shipment.

The maximum number treated in any one month so far is 45,000, but the average falls greatly below this figure. The plant is not provided with appliances for creosoting. Only the chloride of zinc treatment is used. Usually the Wellhouse or tannin method is employed, but the Burnettizing process has also been tried (Eng. News, June 28). The accompanying sample report of the engineer in charge gives an idea of the process of treatment.

The indicators are read and figures made for double runs on two cylinders together. The displacement, or cubic contents of the material, in the run is found by taking the number of cubic feet of solution forced back and deducting this from the cubic contents of the cylinders, less the volume of the empty cylinder cars. In the above case we have cubic contents of cylinders $6 \times 6 \times \frac{1}{4} \times \pi \times 212 = 5{,}994.17$ cu. ft. Volume of 26 cylinder cars at 1.807 cu. ft. each = 46.97 cu. ft. Solution forced back: Indicator zinc tank 12.25 — lowest point 3.80 = 8.45 × 420 sq. ft. (area of tank) = 3,549 cu.. ft., whence 5,994.17 — 46.97 — 3,549. = 2,398.2 = displacement.

The percentage of absorption of the zinc solution may be found by dividing the quantity of the solution introduced by the volume of the material treated. In the above case it is (14 — 12.25) 420 ÷ 2,398.2 = .31, nearly.

Steam is furnished by two 60-HP. boilers, and the blocks sawed from the ends of the ties constitute the greater part of the fuel. The plant is also equipped with a stationary engine, with cylinder 10 × 14 ins., for running the saws; a hoisting engine, a Knowles duplex air pump with steam cylinders 6 × 10 ins., and two Worthington duplex force pumps, with cylinders 3½ × 6 ins. Besides several cooking and mixing vats, there are two storage tanks, one for zinc solution and one for tannin, 16 ft. high and with a cross-section area of 420 sq. ft.

Chemicals are received in car-load lots from Eastern works. They are mixed in the various vats to a solution of the proper strength (0.015% for zinc and 0.005% for tannin), and forced into the storage tanks by means of a steam ejector pump. Glue is added to the zinc solution at the rate of about 2 lbs. of glue to 100 gallons of solution. The strength of the zinc solution is tested in the storage tank with the hydrometer after each run and restored to the proper standard by additions from the mixing vat.

The strength of the tannin solution is maintained by additions proportional to the amount of tannin solution absorbed, plus the absorption of the zinc solution in the same run. The tannin being introduced subsequently is robbed of its strength by the zinc which it finds in the timber.

The solution is drawn from either tank to either cylinder through 8-in. pipes by exhausting the air in the cylinders. Pressure is maintained through the Worthington pumps. The solution is forced back to the tanks by air pressure through the 8-in. inlet pipes or through 4-in. overflow pipes. There are more than 300 valves of various kinds and sizes in and about the works.

The works have not been run continuously since installation, but have usually closed down during the winter months. The total amount of material treated up to the beginning of 1894 (reducing piling and other timber treated into its tie equivalent by allowing at 4 cu. ft. per tie) is 1,853,839 ties, at an average cost for labor, chemicals and fuel of 14.94 cts. per tie. No account is made of interest or depreciation of plant.

The cost of treatment has somewhat decreased since the installation of the plant, owing partly to the decreased cost of chemicals and labor, and partly to greater efficiency gained by extended experience. The cost for the month of June, 1894, was but 10 cts. per tie.

The results so far have been fairly satisfactory, although some of the treated ties are now being removed on account of decay. Many, however, of those treated in 1885 are still sound. It is believed that the results would be far better if the railway company did not pursue such a "hand to mouth" policy. The timber does not have time to season before treatment, nor time to harden before being put into service. This year contracts for timber were awarded in Chicago on Jan. 10. By April 10 the wood preserving works were running on freshly-cut timber, and before May the newly-treated ties were going into the track. It is believed that if the timber were allowed to season thoroughly before treatment, and to harden thoroughly before using a life of 15 years might reasonably be expected for the average tie.

There are numerous spots in New Mexico where the soil is impregnated with alkali; so much so in places that no vegetation can live. In other places nothing but a worthless salt grass thrives. Where the roadbed has been made over these spots it is noticeable that the ties have not decayed, many of the original untreated ties laid in 1879 being still perfectly sound. It seems probable that the apparently worthless substance with which these soils are impregnated might be utilized in some chemical process for the preservation of timber.

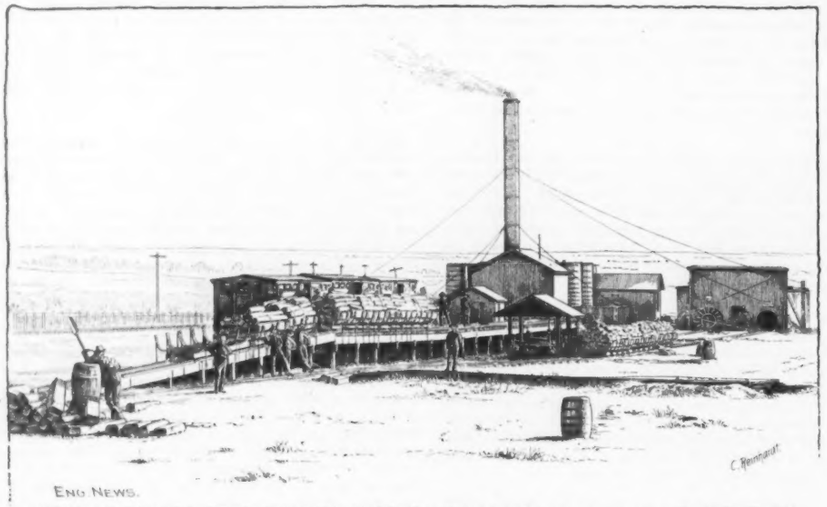
The Las Vegas works are operated by the railway company, under the Division Superintendent. Mr. G. W. Noyes is the general foreman at the works.

No. ———. Las Vegas Wood Preserving Works. Date April 23, 1894.

No. of cylinder.	No. of run.	First vacuum commenced.	12 ins. indicated.	Commerced steaming.	18 lbs. indicated.	Blow off.	Second vacuum commenced.	14 ins. indicated.	Indicator zinc tank.	Chlorzinc introduced.	Indicator lowest point.	Forced back	Indicator zinc tank.	Indicator tannin tank.	Tannin introduced.	Forced back.	Indicator tannin tank.
6059	1	7:20	7:30	7:30	8:10	12:20	1:20	2:00	14.00	2:00	3.80	4:30	12.25	14.00	5:00	6:30	13.80
6060	2	8:20	8:30	8:30	9:30	1:20	2:20	3:00	14.00	3:00	3.80	5:30	12.25	14.00	6:00	7:30	13.80

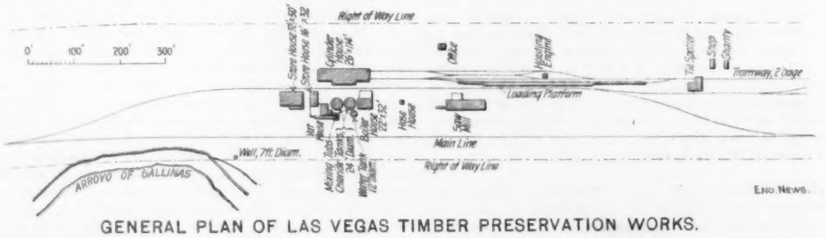
Thermometer, 90; strength, .015; absorption, .31; hydrometer, 150; displacement, 2398.2.

Signed, ———, Engineer.



ENG. NEWS.

VIEW OF TIMBER PRESERVATION WORKS AT LAS VEGAS, N. M.; A., T. & S. F. RY.



GENERAL PLAN OF LAS VEGAS TIMBER PRESERVATION WORKS.

An International Exposition is to be held in Baltimore in 1897, and it is stated that it will surpass in extent any exposition ever held in the United States, with the exception of the Centennial and the Columbian Exposition. It is proposed to spend nearly $2,500,000 on buildings and grounds. The officers of the association which has the project in charge are: President, Lloyd L. Jackson; Secretary, Maj. Geo. C. Wedderburn; Acting General Manager, Maj. Frederick Brackett.

THE TREATMENT OF SEWAGE BY FEROZONE AND POLARITE.*

By Arthur Bowes, Assoc. M. Inst. C. E.

The system of sewage treatment here described is based on two principal operations; first, the removal of the greater part of the impurities in the sewage by a chemical precipitant called ferozone, and second, the filtration of the liquid through filter beds containing a substance termed polarite. The works required for the treatment of sewage by this system do not differ materially from those used in the case of other precipitation and filtration processes; local requirements of course affecting the design of individual works.

The sewage, on entering the works, is passed through iron screens which strain out the coarser materials suspended in it. Steel wires strained on an iron frame have also been used to form screens. A rake is caused to traverse the face of the screen to clear away the rubbish arrested by it, depositing it in a perforated tray, where the water is allowed to drain away. This rake may be worked by hand, but is usually so arranged as to be actuated by the flow of the sewage.

The precipitant, ferozone, has been found by Mr. Carter Bell, of Salford, to have the following composition:

	Per cent.
Moisture	20.00
Sulphate of iron, anhydrous	21.17
Sulphate of alumina, anhydrous	22.20
Carbon	7.16
Constituents insoluble in water	12.70
Water of constitution and other matters not determined	16.77

The amount of this substance added is usually 5 to 6.7 grains per gallon of sewage, or 700 to 950 lbs. per million gallons.** The exact amount required must necessarily be determined by the quality of the sewage and the purity of the effluent required. Various methods are adopted for adding the ferozone. It may be suspended in baskets in the inflowing sewage and be thus allowed to dissolve gradually; it may be ground into powder, and afterwards dissolved separately in water and added to the sewage; or automatic mixing machinery may be used. The Keirby mixing machine, which is in use at Royton and Swinton, is actuated by a water wheel 6 ft. in diameter, placed in the inlet channel. It contains a series of radial arms revolving on a central shaft and passing between fixed arms attached to the outer casing of the machine. The essential feature of the apparatus is the arrangement for automatically regulating the addition of the ferozone according to the flow of the sewage. This is done by means of a float and bevel gearing actuating a conical plug which forms the bottom of the chamber containing the supply of ferozone. As the float rises with an increased flow of sewage, the cone falls to a corresponding extent and thus increases the area of the annular space through which the precipitant falls into the mixing chamber below. If the quality of the sewage to be dealt with remained constant, it will be seen that the addition of the precipitant could be effected automatically. The sewage of most towns, however, varies in its impurity, being worse at some times than at others; and a certain amount of attention is necessary to regulate the addition of the precipitant.

After the sewage has received the necessary charge of precipitant, it flows along open channels in which baffles are placed so as to cause thorough incorporation of the precipitant with the sewage. It then flows into the first of the precipitating tanks through a floating trough, so as not to disturb any deposit which may have been previously formed in the tank. Floating boards are arranged to arrest any scum that may be formed on the surface and to prevent it from being carried through the series of tanks to the filters. The tanks are usually of such number and capacity as to deal with the normal flow of the sewage, allowing three or four hours' quiescence for the subsidence of the impurities in each tank; practice in this particular shows, however, considerable variation from the rule stated.

After most of the impurities have settled in the tanks, the sewage is passed by floating outlet pipes on to the filter beds. The active ingredient of the filters is an insoluble mineral substance known as polarite. It is very hard and porous, and has a remarkable power of absorbing and giving off oxygen. An analysis by Sir Henry Roscoe indicated the following composition:

	Per cent.
Magnetic oxide of iron	53.85
Silica	25.50
Lime	2.01
Alumina	5.68
Magnesia	7.65
Carbonaceous matter and moisture	5.41

In bulk, polarite weighs about 2,125 lbs. to a cubic yard. Being insoluble in water, it never requires to be renewed. Unlike spongy iron, which has been found to rust when used for filtering purposes, polarite does not enter into chemical union with the oxygen which it absorbs from the atmosphere. It has also the advantage of not becoming choked in winter by the freezing of the water passing through the filters; possibly because of the rapid rate at which filtration through this material can be carried on. During the severe winter of 1892-3 the polarite filters used at Reading for the purification of the water supply of the town, continued to work uninterruptedly, although the ordinary filters were blocked with ice.

It is advisable to provide several filters of small area rather than a smaller number of large filters, in order that the requisite time may be given to permit aeration of the polarite to take place in each filter, and to cleanse the sand on the surface. The filters are usually composed of a top layer of sand 10 to 12 ins. in thickness; a layer of polarite and sand mixed in equal quantities, 12 ins. thick; a layer of sand 4 to 6 ins. thick; and a bottom layer of gravel and shingle containing 4-in. drain pipes for carrying off the purified effluent. The liquid to be filtered is distributed by mushroom valves at various points over the surface of the filter, so as to cause the least possible disturbance of the upper layers. Through such a filter, ordinary sewage, after precipitation and subsidence, may be passed at the rate of 960 to 1,200 U. S. gallons per sq. yd. per 24 hours (4,700,000 to 5,800,000 gallons per acre). At Royton 1,440 gallons per sq. yd. per 24 hours (7,000,000 gallons per acre) are passed through the filter with satisfactory results. Recent experience tends to show that, within certain limits, by increasing the depth of polarite through which the filtration takes place, the speed of the action may be correspondingly increased. It is worthy of remark that at the Reading Corporation Water-Works 18,000 gallons of water per sq. yd. of filter are purified in 24 hours (87,000,000 gallons per acre).

When the upper layer of sand becomes clogged by the accumulation of impurities, a quick and economical method of cleaning it by upward washing has been devised. An adjacent filter has its outlets closed, and the liquid is allowed to accumulate until it has attained a head of a few inches above the normal level. Connection is then made between the outlet channels of this filter and the bottom of the filter to be washed; and the purified effluent from the former forces its way upwards through the latter filter, carrying the dirt to the surface, whence it is scraped by manual labor. This operation occupies about 40 minutes. If a less time than this be allowed, the upper part of the sand is disturbed by the force of the current through it.

In August, 1888, Sir Henry Roscoe, in a report relating to the sewage purification works at Acton, gave the following average analysis of the filtered effluent after treatment by ferozone and polarite:

Parts per 100,000.

Chlorine	6.400
Free ammonia	0.406
Albuminoid ammonia	0.025
Oxygen absorbed from permanganate of potash in four hours	0.325

In August, 1890, Mr. Carter Bell took samples of the sewage and effluent from the same works and reported the following results of his analysis:

Parts per 100,000.

	Sewage.	Effluent.
Total solid matter	361	76
Suspended "	306	none
" mineral matter	190	none
" organic matter	116	none
Solids in solution	55	76
Mineral "	35	49
Organic "	20	27
Chlorine	5	6
Oxygen required for 15 minutes	1.280	0.040
" " three hours	2.550	0.240
Free ammonia	6.400	0.220
Albuminoid ammonia	0.700	0.035

In 1889 Dr. Arthur Angell reported the following results of analyses of filtered effluent from the Hendon Sewage Works:

Parts per 100,000.

Free ammonia	0.0312
Albuminoid ammonia	0.0080
Chlorine	8.0000
Solids in suspension	None.

In 1880 Mr. Carter Bell reported the following results of analyses of samples filtered through polarite obtained from the experimental works of the Salford Corporation:

Parts per 100,000.

	Sewage.	Effluent.
May.		
Chlorine	2.20	0.920
Free ammonia	1.80	0.016
Albuminoid ammonia	0.73	0.015
June.		
Albuminoid ammonia	0.54	0.05
	0.58	0.06
	0.44	0.06

As the amount of the precipitant required to bring about the subsidence of the impurities is small compared with the quantity required in other precipitating processes, it is natural to expect that the weight of the sludge deposited in the tanks will be proportionately less than that formed by those processes. In the Salford experiments referred to, comparative tests were made on this point by Mr. Arthur Jacob, the result being that the ratio of the amounts of sludge produced by the International (ferozone and polarite) process and the lime process was 1 to 2.46. On account of its comparatively small bulk the sludge is richer in its manurial properties than most sludges; for it contains the same amount of the organic constituents of sewage combined with less inert mineral and earthy matters. An ingenious method of removing the sludge is in operation at the Swinton sewage works and appears to be effective with tanks of a moderate size. The tanks are cylindrical, with flat bottoms. In the vertical axis of the tank is a wrought iron shaft, which, on being rotated by bevel-gearing and a hand winch, carries round with it a perforated outlet pipe, placed a few inches from the bottom of the tank, where it dips into the sludge. The central end of this perforated pipe is connected with an outlet sludge pipe, which is carried up the side of the tank to within about 18 ins. of the surface of the water and is provided with a stop valve. With the tank full of water, there is thus a head of 18 ins. above the final outlet of the sludge, and this pressure is sufficient to force the sludge through the perforations in the radial pipe upwards through the outlet; while, by means of the gearing, the radial pipe can be caused to traverse the whole extent of the circular bottom of the tank. This cleansing operation is, of course, only necessary when sufficient sludge has been deposited to render its removal desirable. One advantage of this arrangement is that the cleansing is carried on without emptying the tank; indeed, it is stated that the process of precipitation need not be interrupted. Particulars are given in the accompanying table of sewage treatment works which have been constructed for the use of the method described.

Particulars of Sewage Treatment Works Employing the International (Ferozone and Polarite) Process.

	Acton.	Huddersfield.	Royton.	Southampton.	Swinton.
Date when the process was first used	1886	1893	1892	1886	1890
Population dealt with	....	96,000	13,000	13,000	16,000
Gallons* of sewage treated per day	520,000	6,000,000	310,000	600,000	360,000
Gallons of sewage** per day per acre filtering area	12,000,000	6,500,000	2,000,000	....	5,000,000
Ferozone used per gallon of sewage	....	4.4 to 8.3 grs.	About 6.5 grs.	....	6.5 grs.
Capacity of precipitation tanks, gallons	540,000 (3 tanks)	1,370,000 (24 tanks)	660,000 (6 tanks)	900,000 (2 tanks)	290,000 (4 tanks)
Area of filters, sq. ft.	1,854 (2 filters)	40,140 (24 filters)	7,200 (8 filters)	3,150 No filters.	(4 filters)
Constitution of filters	....	Sand, 9 ins.; polarite, 6 ins.; sand, 4 ins. mix'd = 10 ins.; sand, 3 ins.; brkn stone 9 ins.	Sand, 9 ins.; polarite and sand mixed, 10 ins.; sand 3 ins.; gravel, 6 ins.; boulders, 6 ins.	.....	Sand, 9 ins., polarite and sand mixed, 12 ins.; sand, 4 ins; gravel, 5 ins.; loose broken stone, with pipes, 4 ins.
Disposal of sludge	Pressed.	Pressed and burned.	Pressed and burned.	Sold to farmers.	Pumped into lagoons for use by farmers.

* U. S. gallons. ** Computed and added for convenience.—Ed.

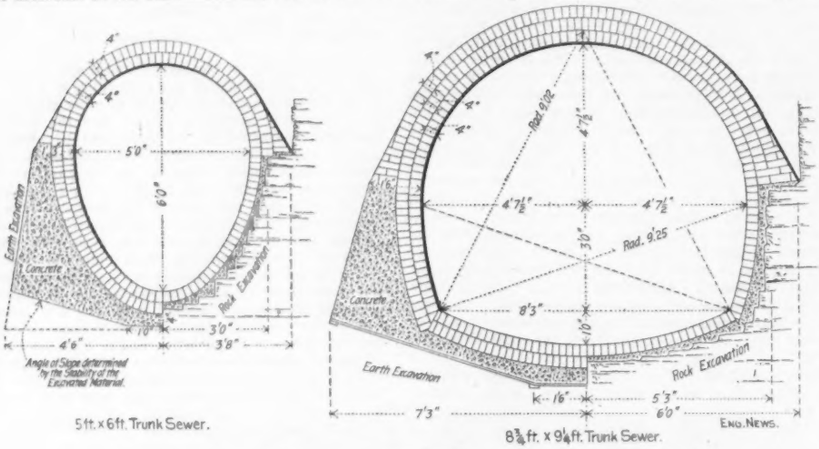
The railway across the Isthmus of Tehuantepec is reported as practically completed, and it is to be opened to traffic this month. This road is 192 miles long, from Coatzacualcos, on the Gulf of Mexico, to Salina Cruz, on the Pacific. As a competitor with the Panama railway, it would make the distance from New York to San Francisco, 4,325, against 6,107 miles, by way of Panama. This is a saving of 1,182 miles in distance, and fully three days of water travel. The Isthmus of Tehuantepec has been discussed as a railway route since 1842, and in 1878 Mr. Edward Learned, of New York, completed about 22 miles of line, when the contract was annulled. In 1882, a contract was let to a Mexican by the name of Sanchez, who built about 60 miles of wretched road. In 1888, the Mexican government let the contract to Edward McMurdo, of London, and on his death, a new contract was made, February, 1892, with Messrs. C. C. Stanhope, of England, and I. M. Hampson and E. L. Corthell, of the United States. As the original appropriation was exhausted, a new contract was made in December, 1893, with Stanhope & Co. to complete the final 40 miles of the road, and this is the contract now declared finished and completing the railway from ocean to ocean. Mexico proposes to spend about $4,000,000 more on harbor and terminal facilities at the two ends.

*From Proc. Inst. C. E., vol. CXVII., session 1893-4, part III.

**All gallons have been reduced to U. S. measure.—Ed.

THE WEST SIDE TRUNK SEWER, ROCHESTER, N. Y.

An interesting trunk sewer is being built at Rochester, N. Y., under the direction of the West Side Sewer Commission, with Mr. Will E. Crane as engineer and Lee & Minahan as contractors. The members of the commission are Messrs. Frank S. Upton, George B. Swikehard and Horace G. Pierce. We are indebted to Mr. Crane for the following information and the accompanying illustrations:



FIGS. 1 AND 2. SECTIONS OF TRUNK SEWER, ROCHESTER, N. Y.
Will. E Crane, Engineer.

The main trunk sewer is 17,700 ft. in length, with an extension of lateral sewers of 13,000 ft. Two miles of the main trunk is in or through public highways. The remaining length passes through a deep ravine, whose banks are abruptly vertical to a height of 10 ft. at the beginning to 98 ft. at the junction with the Genesee River, into which the sewage is at present to be discharged.

The trunk sewer at the beginning is 5 ft. in diameter (egg-shaped, as shown by Fig. 1) and increases to 6, 6¼, 8, 8½, 9 and 9¼ ft. at the outlet, a section of the latter being shown by Fig. 2. The minimum grade is 1 in 500 for about one-third of its length. The remaining length has grades of 1 ft. in 150 and 1 ft. in 200. There is 1,980 ft. of 9½ ft. tunnel. The sizes pass from egg-shaped to circular and thence to the horseshoe section. The outer shell is concrete rubble masonry to 1 ft. above spring of arch, lined and arched with brick. The invert has one and two rings of brick imbedded in concrete to bed rock.

The 4½-ft. egg-shaped portion of the lateral sewer (which sewer diminishes to 2½ ft. in diameter, is designed to be similar in construction to that already described, with a two-ring brick arch and a two-ring invert when in earth and one-ring invert in rock. The 5-ft. section of the trunk sewer, as shown, has the same thickness of invert and arch. The 6¼-ft. circular and egg-shaped sewer and all the larger sizes have concrete foundations, resting on 1-in. boards, when not in rock. The 6¼-ft. sewer has two rings of brick for the invert lining and three rings for the arch, as do all the larger sewers, except when on a rock foundation or in tunnel. When on rock these larger sewers have but one ring of brick in the invert, except for one special section, where the rubble masonry is carried part way beneath the invert and the invert lining consists of but one ring of brick. In solid rock tunnel there is no lining except one ring of brick on the invert resting on a thin layer of concrete.

The fall is so great through the ravine in places, 1 ft. in 23, that five drops, from 6 to 13 ft. each, have been designed and one shaft 112 ft. deep. The drops are constructed like the section, Fig. 3, which shows a 13-ft. fall. The curve is a parabola reversed in a circle to connect with the lower section.

The 112-ft. shaft is provided with an 8-ft. sump and is shown in plan and section by the sketches, Figs. 4 and 5. The shaft is only a temporary outlet to get to the river below the lower falls; provision is made to eventually extend the sewer to a point lower down the river to a purification plant.

All the sewage of the city is at present discharged directly into the Genesee River at from 10 to 15 different points.

About 1¾ miles of the work had been opened up in May, 1894, at about six different places, and about 1,300 ft. of open cut sewer and 550 ft. of tunnel completed, including the 13-ft. drop, Fig. 3. The work has progressed slowly on account of litigation in obtaining right of way.

The estimated cost of the trunk section was $385,000, for construction only, and a total of $450,000, including right of way and other expenses.

THE DESIGN OF FERRY STEAMERS.

(With inset.)

Three papers on the design of steamboats for ferry service have recently been read before technical societies. One by Col. Edwin A. Stevens, President of the Hoboken Ferry Co., read at the last annual meeting of the Society of Naval Architects & Marine Engineers, described the ferryboats plying in New York Harbor, with special reference to the newer boats built under his direction. One by Mr. Andrew Brown, M. Inst. C. E., read before the Institution of Civil Engineers, described three peculiar types of ferryboats operating respectively on the Mersey, the Thames and the Clyde. The third paper, by Mr. Charles Jones, describes two steamers built by the author's firm for the ferry across the Mersey from Liverpool to Birkenhead, and superseding the paddle-wheel boats formerly used.

We have reproduced on our inset sheet and in the illustrations herewith the drawings accompanying these several papers, and reprint the papers themselves, considerably condensed and partially in abstract, herewith. Colonel Stevens' paper was as follows:

Legally, a ferry is the continuation or prolongation of a highway over a navigable stream. In other words, there is a legal likeness between a ferry and a bridge. The ferryboat of to-day is not only in its functions, but in its construction, a hybrid between a vessel and truss bridge.

The ferries of New York are, and will be for many years, the most important of the world. The requirements and limitatons of design in New York ferryboats are as follows:

The hull must have rigidity to keep its shaft in line; it must have a longitudinal stability to resist burying with a large load on the bow, and must steer well even when trimmed by the head; it ought to have a fair manoeuvring power when fore-reaching with the engines stopped; it must carry heavy team loads without straining, should be of good shape to fight ice, with an easy form; its weight should be kept as small as possible; its draft ought not to exceed 11 ft., and its stability should be enough for safety and no more. The engine must start and reverse quickly; it should be capable of great variations of power without sacrificing economy at its usual rate of working, or, say, two-thirds power; its balance should be as good as can be secured; but, above all, it must be simple, strong and easy of operation, repair and inspection, and, let me repeat, must reverse most promptly. The boilers should be free from any suspicion of priming, and should be able with least possible waste to meet the varying demands. Steam has to be stored at each stop, or some other method of attaining the same object must be devised. As fired in service the boilers do not supply enough steam to run the engine continuously. The result is that at the beginning of each trip the steam pressure is above the average, and at the end of the same, below. Skillful firing, while most desirable, is hard to secure, as it demands more than average intelligence, while the work is discouraging because of the impossibility of meeting all demands without some waste through the escape pipe.

The auxiliary machinery of modern ferryboats consists of an air pump, circulating pump, feed pump, fire and bilge pump, steering engines, electric light engines and dynamos, and an engine and fan used for ventilating and blowing heated air into the cabins.

The designs of New York ferryboats divide themselves generally into two classes, paddle-wheel vessels and screw propellers. The paddle-wheel engines have been mostly of the beam type, with jet condensers, carrying pressures ranging from 30 to 50 lbs. The wheels in these engines are radial. This engine was really very well suited to its work and still retains its place beside its most modern competitors.

Low-pressure inclined engines have been built and used to a certain extent, but have not met with the same favor as the beam engine. The best examples, however, of side-wheel ferryboats have been of the inclined type. I allude to the "Erastus Wiman" and "Robert Garrett," of the Staten Island ferry. These vessels have compound inclined engines, and, I believe, the only feathering wheels that have ever been successfully applied to ferrywork in New York waters. The paddle-wheel engines, as a whole, have the objection of not stopping the vessel as efficiently as the screw. They take up a large deck space, both for the engines and for the wheels. They have the advantage of allowing the vessel to be more easily steered when fore-reaching, but at the expense of a loss in manoeuvring power at low speeds, especially when starting. The beam engine has great simplicity, is economical in first cost, and in ferry service, even at the present day, in coal consumption. The necessity of balancing the vessel forbids the placing of the wheels on the midship section. In consequence the ends of the boats are apt to steer differently. Paddle-wheel engines give a burying moment from the high position of the shaft, and the effect of this moment is exaggerated when the vessel is heavily loaded by the head, resulting in a loss of manoeuvring power.

On crowded ferries the paddle-wheel must give way to the propeller. Screw propeller vessels built for New York have all been modifications of one type. They have a rigid shaft running from end to end of the vessel, driven by one or two engines with a screw at each end. A ferryboat was built and operated on one

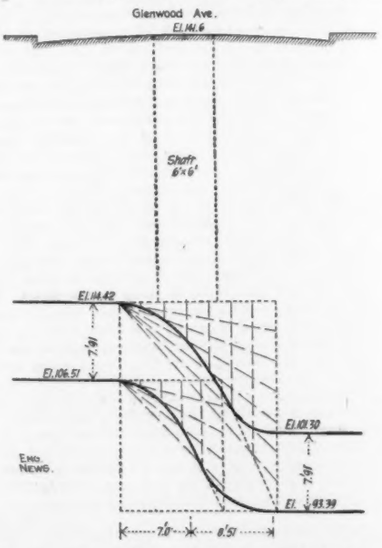
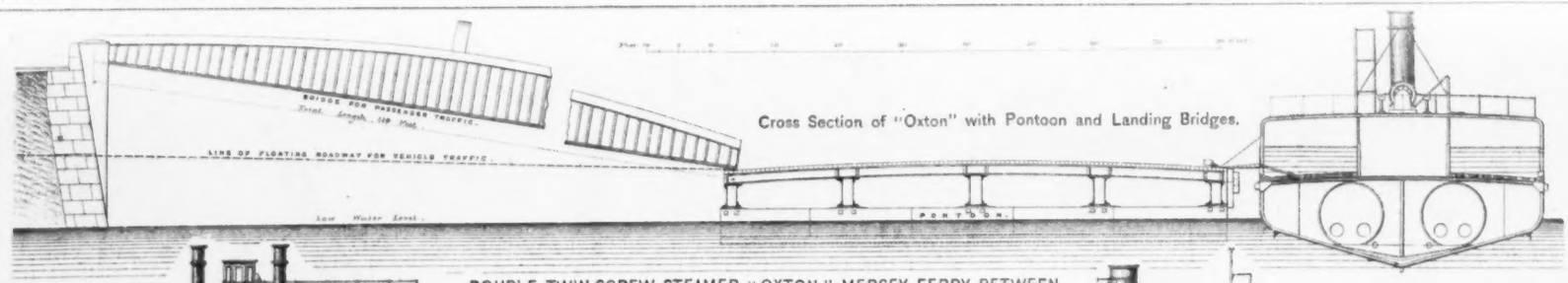


Fig. 3. 13-ft. Drop in Rochester Trunk Sewer.

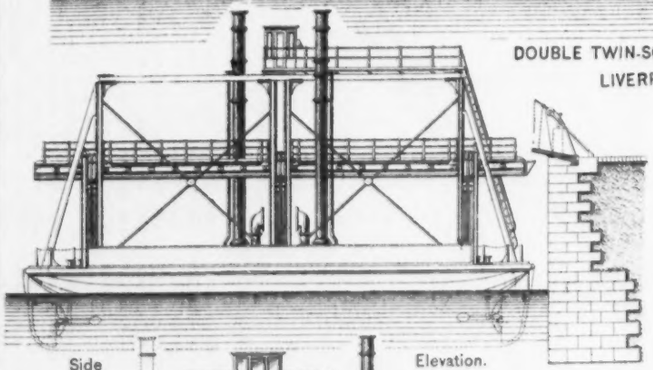
of the Northern rivers with a single screw, and at least one boat in New York harbor has been so operated on account of the breaking of one of her propellers. While boats thus designed show a greater economy in coal at the same speed, the loss in backing power in one direction, the difference in steering, and the fact that the vessel's head falls off in backing are sufficient to compensate for the greater wastefulness of the two-screw arrangement.

Two boats with a screw at each end driven by independent engines were built in the '60's or in the early '70's by Mr. Livingston Brady. They were built for

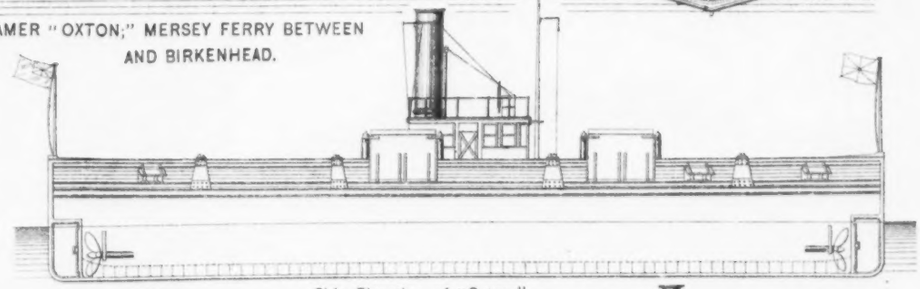


Cross Section of "Oxton" with Pontoon and Landing Bridges.

DOUBLE TWIN-SCREW STEAMER "OXTON," MERSEY FERRY BETWEEN LIVERPOOL AND BIRKENHEAD.

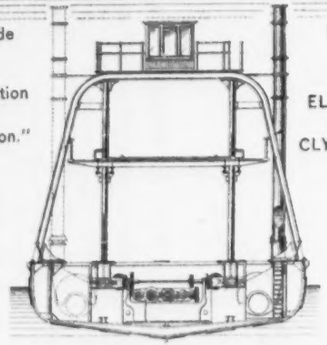


Side Elevation.

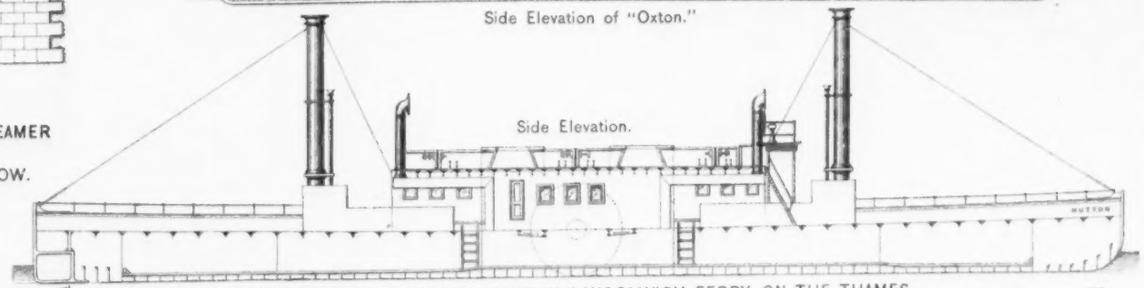


Side Elevation of "Oxton."

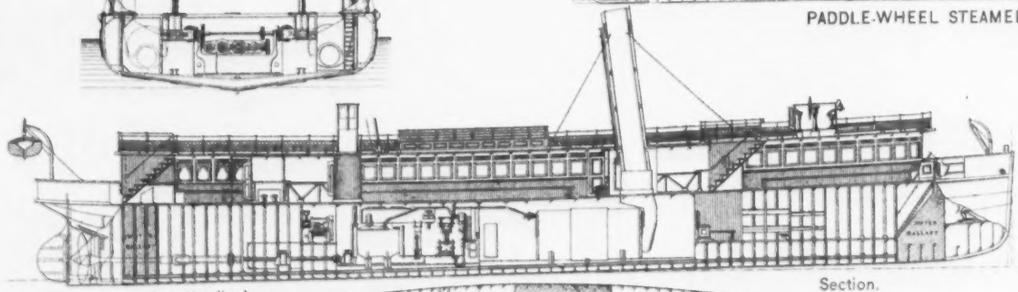
Cross-Section of "Finnieston."



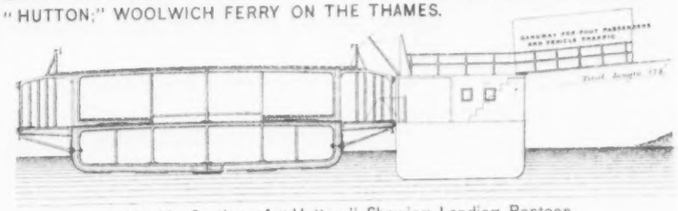
FOUR-SCREW ELEVATING DECK STEAMER "FINNIESTON." CLYDE FERRY, GLASGOW.



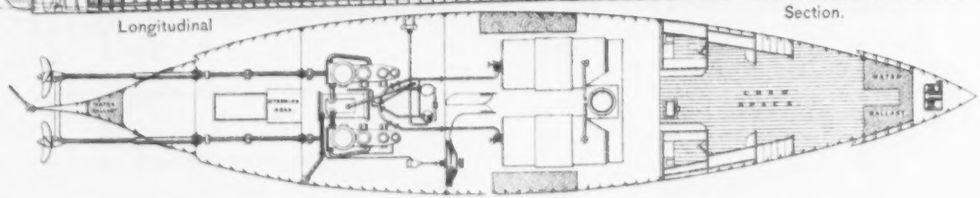
PADDLE-WHEEL STEAMER "HUTTON," WOOLWICH FERRY ON THE THAMES.



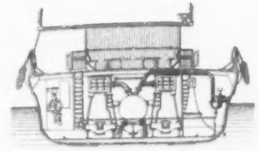
Longitudinal Section.



Midship Section of "Hutton," Showing Landing Pontoon.



Plan of Machinery Deck.



Midship Section.

TYPES OF ENGLISH FERRY STEAMERS.

TWIN-SCREW STEAMERS "MERSEY" AND "WIRRAL," MERSEY FERRY BETWEEN LIVERPOOL AND BIRKENHEAD.

CHAS. HART & SONS, LITH., 83 VESEY ST., N. Y.

use on the Mississippi. The quick-water from their wheels proved so destructive to the levees that their use had to be abandoned.

It has been proposed to propel ferryboats with twin-screws of the ordinary type, and vessels have been driven on the Mersey with four screws, two on each side, attached to rigid through shafts. These vessels are said to have great manoeuvring power, but are very small compared to the New York boats. The screws under any twin-screw arrangement would be more exposed to damage by ice and floating wreckage and the machinery is more complicated than in vessels of the present New York type. The necessity for prompt reversing has led to the adoption of two engines with the object of securing two high-pressure cylinders with crank pins at right angles to each other. The need of this arrangement would hold good with twin-screws or with independent shafts at each end of the vessel, and would involve an undesirable complication.

The first screw boat built for traffic in New York harbor was the "Bergen," of the Hoboken ferry. The troubles prophesied for the "Bergen" never happened. Her shaft stayed in line and did not heat in the bearings; it has not yet broken, nor did she break propeller blades in ice; she did stop quickly, and, in fact, most promptly. She has proved herself in service a successful and popular vessel. But, like everything human, she had her faults. It is regrettable that some vessels for other lines were built without profiting as fully by the "Bergen's" experience as might have been the case. How the "Bergen's" shortcomings were met in subsequent boats may be best shown by a comparison with the "Netherlands," a boat just completed.

The midship sections of the "Bergen" and "Netherlands" are shown herewith. It will be noticeable that the beam of the "Netherlands" both at the gunwale and at the load water line, is greater than the "Bergen's," that she is fuller in the garboards and that the system of framing is quite different. The "Bergen's" stability, while ample for a single deck vessel, is not as great as desirable for double decking, which has become a necessity on many routes, notably on the Barclay St. ferry. The increased beam at gunwale shortens the overhang of the guards, a most desirable feature, while the increased flare of the side decreases the risk of damage below the water-line in the case of collision; and it must be borne in mind that every ferryboat has to receive many a hard knock in collisions.

In general shape the "Netherlands" is fuller in the ends of her upper body, thus insuring greater longitudinal stability, and her lines show more power with a fairer form. The most marked change is in the greater "cut out" at the ends. The distance between the stems and stern posts in the "Bergen" is ft.; in the "Netherlands," 16 ft.

The racks which guide the boat on entering her slip and retain her in position are made of pile work. With increasing weight and speed of boats the repair and renewal of these racks becomes a most important feature. A limit is set to draft by the necessity of having as short a pile above the mud as possible. Excessive stability or rigidity is objectionable because these qualities add to the severity of the impact against these racks. When the rack is struck the engines are usually stopped, and the vessel is then forging ahead by her momentum (or fore-reaching); if left to herself she will keep her head against the rack, pushing it out as she advances. This in itself is injurious, but not to so great an extent as the first blow if delivered at an unfavorable angle.

The "Bergen," it was found, could not be readily steered after stopping the engine, and, consequently, was apt to hit the rack a destructive blow, and to "ride it down." To avoid this, the only means was to check her headway by backing. This involves a loss of time. The changes in the "Netherlands" to avoid this fault were the greater "cut out" above mentioned, an increase in the breadth of the rudder and the use of a three-bladed propeller of 11 ft. pitch, instead a four-bladed one of 9 ft. 3 ins. pitch in the "Bergen." These means have met the end aimed at in a very gratifying manner.

In the construction of the "Bergen" the longitudinal bulkheads were designed and built mainly to subdivide the hull, and the deck was of the type usual in river craft. The decks of all ferryboats previous to the "Netherlands," as far as I am informed,* were platforms resting on and overhanging the hull, and held down by bolts at the gunwale. The objection, however, to this design was the fact that the beams in the passenger cabins were the same size and strength as under the team gangways, the weight of the deck frame under the cabins being thus largely in excess of what was necessary. I may mention that observation and experience seem to justify the figuring of team decks for a moving load of 400 to 500 lbs. per sq. ft., and on lower passenger decks of about 120 lbs. The weight of the usual design of deck figured for these loads is great, and becomes excessive if steel is used. In that case the rigidity of the deck also becomes objectionable on account of its punishing power on the racks.

The midship section of the "Netherlands" explains the method taken for meeting this difficulty. Steel bulb angles, spaced about 8 ft. apart, are used for the main deck-beams, and are bent down so as to go under the ledger plate in the usual fashion. Between the coamings in the team gangways these beams are covered over with a system of bridge plates, producing the corrugated section shown in the drawings. The corrugations are filled on the upper side with white pine nailing strips laid in a waterproof mixture. To those nailing-strips the sheathing necessary for the safe handling of team traffic is attached. The iron deck-beams have a firm attachment to the upper chord of the bulkhead structure, which carries a heavy longitudinal plate, forming the upper member of the longitudinal girder, to which I shall hereafter call attention.

The deck-beams for the passenger space are of white pine; they foot on this longitudinal plate, and are firmly attached thereto. These beams serve the double purpose of carrying the passenger load and of acting as struts to hold the guard structure in its position. These duties, however, require no such strength as would be required for deck-beams under the deck. The saving in weight is very considerable, and the trough sections running fore and aft are a very valuable feature in the longitudinal strength of the hull.

As I have before mentioned, the longitudinal bulkheads of the "Bergen" are intended mainly to subdivide the hull. In considering the strains to which the structure was subjected, it appeared to me advisable to make further use of these bulkheads in securing longitudinal strength. In the "Netherlands" the bulkhead construction is carried to the deck by means of vertical and diagonal angles. Over the top is worked horizontally the longitudinal plate to which I have alluded, and an angle which receives any thrust from the end of the passenger deck-beams, and further serves to strengthen the upper member of the bulkheads. Forward of the collision compartment the bulkheads are continued in the shape of lattice girders to the ends of the boat. These longitudinal girders coincide closely with the bulkheads between the team and passenger spaces, and, therefore, serve to take up the strains due to the weight of the larger portion of the joiner work in a most direct and effective manner.

The sections of the "Netherlands," as a whole, are those of a deck truss bridge; the longitudinal bulkheads and their continuation form the trusses; the bottom is formed by the bottom of the vessel, and the deck by the deck-beams and trough sections. The spaces in the wings beyond the longitudinal bulkheads

* It was developed in the discussion that the Pennsylvania R. R. ferryboats "Cincinnati" and "Washington" were built with decks which are designed to form a top chord for the longitudinal frames.

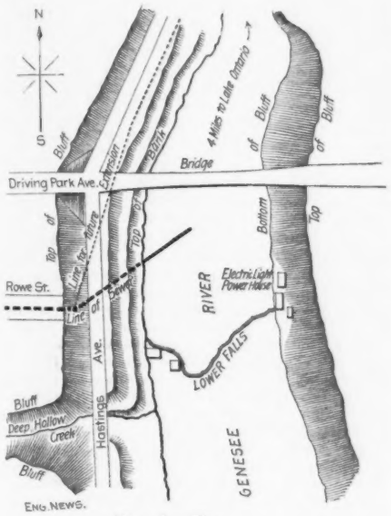


Fig. 4. Plan.

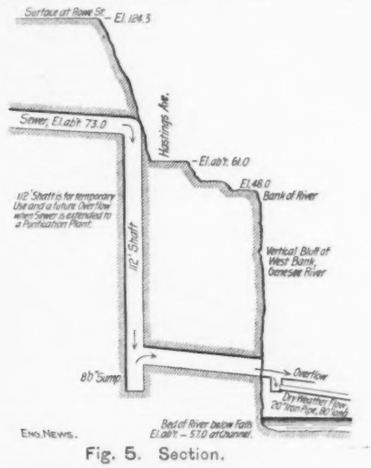
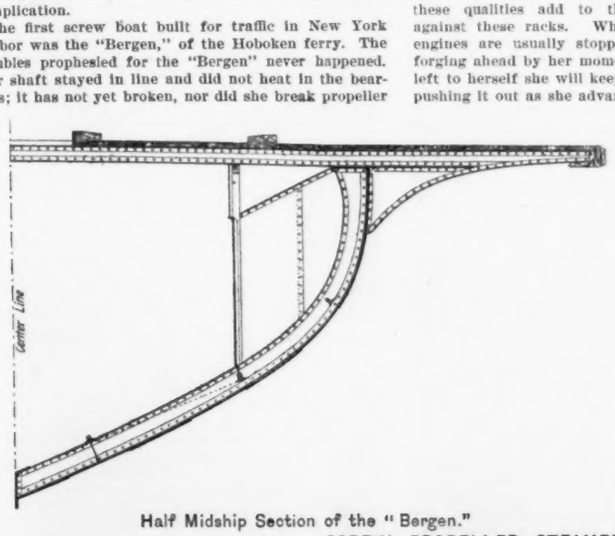
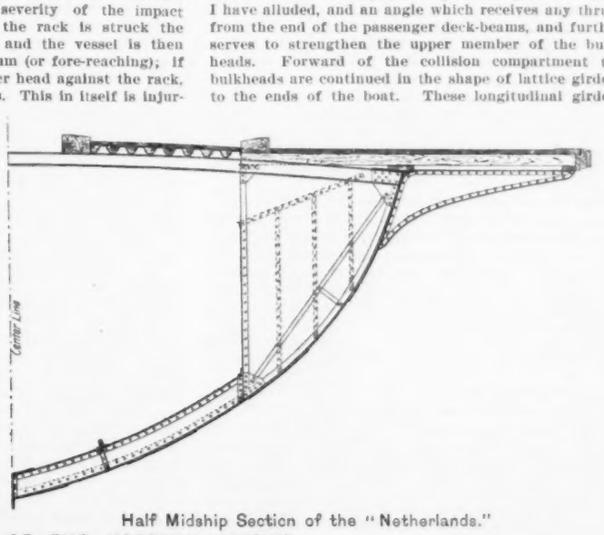

Surface at Rowe St. – El. 184.3
Sewer, El. abt. 73.0
Hastings Ave.
El. abt. 61.0
El. 46.0
Bank of River
112' Shaft is for temporary Use and a future Overflow when Sewer is extended to a Purification Plant.
112' Shaft
Vertical Bluff of West Bank, Genesee River
8b'Sump
Overflow
Dry Weather Flow, 20" Iron Pipe, Rt. Iond.
ENG. NEWS.
Bed of River below Falls El. abt. – 57.0 at Channel.

Fig. 5. Section.

VERTICAL DROP OF 112 FT. IN ROCHESTER TRUNK SEWER.



Half Midship Section of the "Bergen."



Half Midship Section of the "Netherlands."

SCREW PROPELLER STEAMERS OF THE HOBOKEN FERRIES.

were considered and treated merely as buoyancy chambers requisite in the peculiar service for which this peculiar bridge was designed. The passenger decks may be considered much in the light of a covered passenger platform, bracketed to the side of the truss bridge. The necessity for providing for collisions with ice and other vessels insures more than sufficient strength for any such purpose.

The design of the "Netherlands' " engine resembles that of the "Hamburg" and "Bremen," the two vessels that preceded her. The "Bergen" has a triple-expansion engine 18½, 26 and 42 in. cylinder diameters by 24-in. stroke, designed for 160 lbs. of steam.

The "John McCullough," of the Erie ferries, has one compound, the "Cincinnati," and "Washington," of the Pennsylvania ferries, and the "Hamburg," "Bremen," and "Netherlands" of the Hoboken ferries have two compound engines. The "Netherlands" engines are 18 and 38 ins × 28-ins. stroke. The increased stroke was adopted on account of the advisability of an increased pitch of wheel, for reasons mentioned above. The favorable comparison between the triple and compound is due largely to the fact that the auxiliary machinery of the "Bergen" is very extravagant. Although she has the advantage, for coal economy, of an air pump attached to the low-pressure engine, this gain is more than offset by the waste in her other auxiliary machinery, and by the fact that the compound engines referred to were designed to give variable points of cut off by linking up, much after the custom prevalent in locomotives. Variation in power in the "Bergen" has to be provided for by throttling. In designing the "Hamburg's" and "Bremen's" engines it appeared doubtful whether a triple engine could be produced which would give the necessary variations of power to suit the conditions, and the air pump was combined with the circulating pump and made independent, and two compounds substituted for one triple to make an engine that would reverse more promptly. Notwithstanding the fact of the increase of pitch of the screws, this object has been attained.

In the "Bergen" it has been found on several occasions that when the high pressure crank happened to stop on the centre the engine failed to reverse as promptly as desirable. This is felt in loss of time and has not caused any accident. In entering a slip in a service like the New York ferries, where even a few seconds' gain in time is desirable, the certainty that a vessel will back promptly and effectively is of importance. I will confess that when the four-cylindered compound type of engine was first considered, it was adopted partly on account of the supposed gain in balance that it would bring. The result, however, has demonstrated in a very practical way the difference between a statical and dynamical balance.

The boilers of the "Netherlands" are, like those of the "Bergen," of the "Admiralty," or "gunboat" type. In the "Netherlands," however, in order to induce a stronger draft in the lower portion of the boiler, two flues of 6 ins. and two of 8 ins. in diameter are worked below the tubes. This is found to draw down heated gas, and thus secure a more even temperature. The boilers of the "Netherlands" are slightly larger than those of the "Bergen." They are built to stand a pressure of 140 lbs.

The "Netherlands' " whistle can be blown automatically in a fog so as to give the signal customary for the Hoboken ferries. There is also in the pilothouse an electric gear for starting, stopping and reversing the engines of the vessel directly from the pilothouse. This attachment is of great value in giving the pilot more complete control of his vessel. Not having been sufficiently tried in actual service, it must for the present be regarded as more or less experimental. These latter devices are designed by Dr. Chas. E. Ongley.

In concluding his paper Colonel Stevens pointed out that with more accurate determination of the strains in the frames of the hull, reductions in the weight might be possible. In contemplating such reductions, however, it must be remembered that the maximum team load is steadily increasing, and that the severe racking due to heavy moving loads and the strains of collisions must be amply provided for. Further, the hull must be stiff enough to form a foundation for the long rigid screw shaft.

For the propelling machinery, simplicity and strength are the essentials. The necessity of prompt reversing demands two high-pressure cylinders. It is obvious that the "Netherlands' " engines might be improved by combining the two low-pressure cylinders in one and by more careful balancing. For the boiler, the possible saving in weight by the use of water-tube boilers is an advantage not to be despised, but it would be necessary to combine forced draft with it to meet the sudden and large demands for steam. Two interesting, but rather revolutionary, schemes which have been considered involve, in one case, the driving of all auxiliary machinery by hydraulic motors, and in the other case the use of electric motors to drive the propellers and all the auxiliary machinery, a single large dynamo furnishing the current. The accompanying table concluded the paper:

Results of Tests of Hoboken Ferryboats.

Name of vessel	"Orange."		"Bergen."		"Bremen."	"Netherlands."	"Netherlands."
Type of engine	Single cylinder.		Triple expansion,		Double comp.	Double comp.	Double comp.
Cylinder diameters, ins.	46		18½ & 27 & 42		20 & 36	18 & 38	
Stroke, ins.	120		24		28	28	
	Trial trip.	Ferry service.	Trial trip.	Ferry service.	Trial trip.	Ferry service.	Trial trip, p. m. test.
Boiler pressure, lbs. per sq. in.	25	32	114	100	98	110	100.8
Vacuum, ins. of mercury	27	27	27	27	26	24	25.8
Revs. per min., average	22.9	15.4	144	140	115	102	119.0
Average HP., main engine	490	810	700	650	778	603	737.13
Ratio of expansion from point of cutoff	2.1	2.1	9	9	10.3	10.3	13.20
Steam per hour for all purposes, per HP. of main engines, lbs.	27.5	24.7	21.7	22.9	20.7	23.1	19.88
Steam for main engine and circulating pumps	....	....	18.3	....	18.6	19.9	17.35
Steam for main engine only	27.2	24.4	18.3	....	18.1	19.4	16.85
Speed, statute miles per hour	11.5	14.0	12.5	....	12.4	...	12.4
Per cent. of slip	26.0	26.0	13.0	....	13.3	....	14.8
Evaporation per lb. of coal from temperature of hot well to actual pressure, lbs.	8.6	....	9.2	8.42	8.8	....	8.5

The following is the substance of the papers read before the Institution of Civil Engineers by Messrs. Brown and Jones:

Recent Types of Ferry-Steamers.

The "Oxton," on the River Mersey, presents the first example of a ferry-steamer propelled by four screws. This steamer was placed on the station between Liverpool and Birkenhead in 1879. Before the advent of the "Oxton," considerable diversity of opinion existed as to the advantage of four screws, which experience has shown them to possess in many ways over twin screws. With four screws the boat can cross the river with its head set obliquely to the direction of the current; it can also spring itself out from alongside the quay or landing-stage more quickly; it can be stopped when required more promptly and efficiently than with paddles; and greater deck accommodation is secured.

The dimensions of the "Oxton," are: length 130 ft., beam 45 ft., depth 14 ft., average draft 7 ft. 6 ins. The vessel is divided into eight water-tight compartments, with a view to render her practically unsinkable by collision. She is fitted with two carriage-gangways on each side, which are raised and lowered by steam-power, controlled by a hand-lever on deck, actuating two small donkey engines below, which drive the worm-gear and friction-cones of the machinery in connection with the gangways. When raised, the gangways form part of the bulwarks. She is propelled by two pairs of compound surface-condensing inverted-cylinder direct-acting engines, 19 and 36 ins. × 24 ins.; they work at 100 revolutions per minute with a steam pressure of 65 lbs. per sq. in. The shafts run the entire length of the ship, passing under the sides of the boilers. Steam is supplied by two cylindrical multitubular boilers, 10 ft. in diameter, by 10 ft. 6 ins. in length, having two furnaces, 6 ft. × 3 ft., in each. Attached to the boilers is a superheater, to which are fitted spring safety valves. The propellers are right and left-handed, and are 7 ft. 4 ins. in diameter, 13 ft. 6 ins. pitch, and have each three blades. Each pair of engines is fitted with steam starting-gear, as well as hand-gear worked from the deck. The vessel is also fitted with steam steering-gear.

The "Hutton" represents another type of ferry steamer. This boat is employed to carry vehicular and passenger traffic at Woolwich free ferry on the Thames. The manner of working this traffic differs somewhat from that adopted at Liverpool. The passengers are carried on the lower deck and the vehicles on the upper deck. They go on board from the shore by a bridge gangway, connected with which is a pontoon. This pontoon has also two decks, which are on the same level as those of the steamer. The dimensions of the "Hutton" are: Length, 170 ft.; breadth, moulded, 42 ft; depth to main deck, 7 ft. 3 ins.; height of vehicle deck above main deck, 8 ft. 9 ins.; length of vehicle deck, 58 ft. There are two passenger gangways, and three vehicle gangways with sliding bulwarks on each side of the vessel. Two fore-and-aft and six athwart-ship bulkheads divide the hull of the vessel. Steam and hand steering-gear are provided on the bridge. There are two pairs of diagonal engines, having four cylinders, each 33 × 36-ins., with link-valve motion, and indicating 600 HP. Steam starting and reversing-gear is used. Two independent air- and circulating pumps are worked by auxiliary engines, and there are independent steam feed and bilge-pumps. The paddle-wheels have feathering floats. The two boilers are of steel, 9 ft. in diameter and 17 ft. 3 ins. long. Electric light is fitted throughout, there being 100 16 c. p. lamps. The "Hutton" can carry fully 130 tons of live load (that is, 70 tons of vehicles on upper deck, and 60 tons of passengers on the main deck). In addition to this, it carries 20 tons of coal and stores.

The elevating-deck ferry steamer "Finnieston," recently constructed for the Trustees of the Clyde Navigation, presents considerable novelty in design. This vessel was specially designed and constructed for cross-river vehicular and passenger service in Glasgow Harbor.

Several other schemes were brought before the Trustees, such as swing-bridges, high-level bridges with spiral and other approaches, or hydraulic hoists, subways, floating landing-stages, etc. As regards an elevating deck steamer, some fears arose of the danger to its stability when the platform was raised and loaded with vehicles, and apprehensions were formed that it would be top-heavy and capsize. It was also feared that it would prove too great an obstruction to the navigation of the river, while it was further predicted that during gales and when the river was in spate the steamer would become unmanageable. It was finally decided to adopt the elevating-deck ferry steamer, which it was perceived came the nearest of the several schemes proposed to fulfilling the requirements. The ferry steamer was the least costly (£15,000), and, in addition, it could, if necessary, at any time be removed to another station. The construction of the boat was commenced in June, 1889.

It is unlike any other ferry steamer extant, and might aptly be described as a "floating lift" which lands and embarks passengers and vehicles upon the level of the quay, irrespective of any rise and fall of the tide. The "Finnieston" is 80 ft. long, and 43 ft. broad, the breadth of deck being the same forward and aft, having a rectangular form with the corners rounded off. The lines of the vessel are alike at each end, and the draft of water with a full load is about 9½ ft. Internally, the vessel is divided into 13 water-tight compartments, having 12 steel-plate bulkheads, 6 of which are transverse; thus the danger of sinking through collision is reduced to a minimum. Besides the ordinary main deck, the vessel is provided with a deck which can be elevated and lowered. Six double rectangular columns, three on each side, about 30 ft. apart, are carried into the body of the vessel and are connected with the main deck by heavy steel angles. Their upper ends are bound together by longitudinal and transverse steel girders of "I" section, and diagonally by struts which are secured to the main deck. In the space between each set of columns there is an upright steel screw, having a series of rings or collars by which it is suspended from a steel block fitted with rings of gunmetal on which the collars of the screw revolve. The block is secured to the columns and is placed so that the elevating-deck can be raised to a height of 15 ft. above the main deck. On each of the screws a strong nut of manganese-bronze is fitted, having guides so constucted that they are free to travel between each set of columns, whilst they are prevented by the latter from turning. On the top of each nut a saddle is fitted on which rest two longitudinal girders of "I" section—these girders, four in all, running the entire length of the elevating-deck and carrying the whole weight of the deck and load. Passing through and resting on the girders is a series of transverse beams of "I" section. On the top of these, in a longitudinal direction, are fitted two lines of rails for the conveyance of railway wagons. Between the rails and on each side of them, the platform is decked with pitch-pine planking, and near the middle for a width of 20 ft., the deck is cross-laid with elm for vehicle traffic. The elevating-deck is 78 ft. long, and its extreme breadth is 32 ft., the middle part being railed off from the portion reserved for passengers. It is raised and lowered by means of a set of horizontal triple-expansion engines placed in the center of the vessel under the main deck, the pistons working in a fore and aft direction. These engines drive, by steel gearing, two fore-and-aft shafts, placed one on each side of the vessel under the main deck, each shaft having three worms gearing into a steel worm-wheel fitted to the bottom of each upright screw. When the engine is in motion all the screws revolve simultaneously, thus causing the nuts on which the elevating-deck rests to rise or fall, as the case may be. In con-

nection with this, it may be mentioned that the screws which carry the elevating-deck being in tension, there is no possibility of their being bent, should there be an uneven distribution of the load on the deck. The elevating screws work in unison, and so silently that passengers on the platform are unconscious of its motion.

Independent of the machinery for moving the elevating-deck, the vessel is fitted with two independent sets of horizontal triple-expansion engines, placed athwartship. One of these drives a line of shafting fore-and-aft, and operates the port-screws at both ends of the vessel, while the other drives the shafting for the starboard-screws. The cylinders of both engines are 9, 14½ and 24 ins. by 18 ins. All the engines in the vessel exhaust into one condenser, which is fitted with independent air and circulating-pumps. There are also two independent sets of bilge and feed-pumps, thus enabling the vacuum and boiler-feed to be maintained while the vessel is embarking or discharging her cargo. The starting connections of all the engines are led to a platform, so as to be entirely under the control of one man, the steam and hydraulic reversing-gear ensuring quick action. Steam is supplied by two horizontal tubular boilers, 7 ft. in diameter by 7 ft. 6 ins. long, constructed of Siemens-Martin steel and to Board of Trade requirements for a working pressure of 150 lbs. per sq. in. Each boiler has one furnace, and the total heating surface is 1,100 sq. ft. A rudder is furnished at each end of the vessel, and each rudder has a movable lock-bar, to keep it in position when the other is being used. Though the vessel is fitted with these rudders, it has been found that since it commenced work on its present station, they have hardly, if ever, been used, the vessel being manoeuvred entirely by means of the four propelling screws. These screws are each protected by three guard-rods, so placed as to prevent mooring-ropes, etc., from becoming entangled with them or with the rudders. The vessel has accommodation for about 300 passengers, besides 10 loaded carts and horses, or for the same number of passengers with 6 loaded lorries and 2 loaded carts and horses, or for 600 to 700 passengers only. By means of her four screws she can turn in her own length in less than a minute. Th trip across, a distance of 470 ft., occupies between two and three minutes.

The "Finnieston" has now been at work continuously for four years, during all states of traffic on the river, with difficult and heavy loads, and subject to the most unfavorable stages of the current. She has not been stopped by the highest gale of wind which has prevailed since she started, and she is so thoroughly under control as not to cause the slightest interruption to the river traffic. It may be mentioned in connection with the stability of the vessel that the Clyde Trust, in order to thoroughly satisfy themselves on this point, consulted the late Mr. Bateman and Prof. F. Elgar (who at that time occupied the chair of naval architecture at Glasgow University), and the opinion of these gentlemen was distinctly favorable to the design of the boat.

This type of steamer is particularly adapted for the conveyance of horses, vehicles and railway wagons, as it obviates the great wear and tear and loss of time consequent upon going up inclined slips or approaches which are necessary adjuncts to the old ferry system, and on which there is equal difficulty in descending and ascending with heavy loads. For instance, there is considerable danger if the horses slip, and this danger is increased in frosty and rainy weather. The new system also obviates the necessity and expense of providing so great an extent of ground as is required for these slips.

Another advantage of the elevating-platform ferry steamer is that its application is by no means confined to cross-river traffic, but it may also be adapted for the conveyance of cavalry, ordnance and artillery, between the shore and troopships lying out in the "offing." The only important difference in this application would be that, instead of the elevating-platform running fore and aft as in the "Finneston," it would be transverse, so that the traffic would be embarked by side gangways, and the ferryboat would lie more comfortably alongside the quay or steamer. The services of a boat of this type—having a transverse platform—would be invaluable in the shipment of cattle on board transatlantic and other steamers, which are precluded by the draft from lying alongside the quay, also where the wharf accommodation is insufficient to cope with increasing trade, as is the case at the present time at many ports. In this class of trade the platform could be moved during the passage between the shore and the vessel, and the saving of time thus effected would be considerable as compared with that involved in "slinging" wild cattle on board, or driving them up steep gangways.

The Birkenhead Ferryboats "Wirral" and "Mersey."

The Woodside ferry was, until the opening of the Mersey tunnel, the only direct means of communication between Liverpool and Birkenhead. It enjoyed a monopoly of the traffic between those towns, and, being the property of the ratepayers, the profits derived from the annual transport of 8,000,000 to 10,000,000 passengers were of considerable assistance to the Borough rates. On the opening of the Mersey tunnel a great shrinkage in revenue took place, and for a time it appeared likely that the profits from the ferry would disappear entirely. The Corporation of Birkenhead thereupon set themselves to reduce the working expenses of the ferry if they could not retain the traffic.

The vessels formerly used on the ferry were excellent of their class and date, but their size, weight, low speed and heavy coal-consumption forbade economy. It was decided to build new vessels, and tenders were invited on a specification by the Corporation, but no offers were received in response. The author's firm was then privately approached, and a contract was made with them for two ferryboats, the only conditions being those of length, draft of water, height of deck from water line, and a mean speed of 12 knots an hour, with a Board of Trade certificate for 600 passengers. It was agreed that there should be no interference with the builders by the Corporation or their officials, and that the boats were to be retained by Messrs. Jones & Sons if the conditions were not fulfilled.

Three paddleboats had, up to 1890, been used to maintain a ten-minutes' service; but it was determined by the author that two new boats should be capable of doing the work of maintaining the ten-minutes' service, and that the journey across should be made in four minutes. Then, as in some conditions of tide, the water at the Liverpool landing stage shoaled to 6½ ft., the new vessels, with a normal trim of 5 ft. forward and 7 ft. aft, had to be furnished with water ballast trimming tanks, placed in the fore and the after compartments, and capable of being quickly manipulated so as to bring the vessels upon an even keel. Economy was further secured by arranging that the whole of the underdeck space, except the master's room, should be included in the measurement for propelling power. The nominal register tonnage thus obtained was of great importance in respect of the assessment of damages in cases of collision.

To fulfill the specified conditions the twin-screw steamers "Mersey" and "Wirral" were built in 1890, from the author's designs. Their dimensions are:

	Ft.	Ins.
Length between perpendiculars	144	6
Length over all	150	0
Breadth moulded, on deck	32	0
Breadth moulded, on water line	28	6
Depth moulded	10	9
Depth of hold	10	5

	Per cent.
Ratio of depth to length	13.44
Ratio of breadth (load line) to length	5.07
Coefficient of displacement	0.62

Siemens-Martin steel of best quality was used in the hulls, which were divided by bulkheads into 11 watertight compartments. The water ballast tanks are connected with the circulating pumps, and have a capacity of 22 tons each. A deck saloon extends from stem to stern, suitably divided into three compartments. All the parts of the vessels are fitted with electric light, and are heated by steam pipes. The promenade deck on the top of the saloon is reached by wide stairways; the open-sparred teak seats are arranged as life rafts, according to the system invented by Captain Pinhey. The steersman's position is at the forward end of the promenade deck, and he controls a steam-steering apparatus. Communication between the deck and the engine room is effected by Chadburn reply telegraph.

The propelling machinery consists of two independent sets of triple-expansion engines, 15½, 22 and 36 ins. × 18 ins., driving twin-screws, each 7 ft. 9 ins. in diameter and 14 ft. pitch. The high pressure cylinders have piston-valves and the other cylinders have ordinary slide-valves, all worked in the usual way. A Brown steam and hydraulic starting engine controls each set of engines. The surface-condenser, common to both sets of engines and placed between them, is circular, of cast iron, with brass tubes having a surface of 1,531 sq. ft. The starting gear is at the forward end of the engine room, and all handles are brought conveniently together, and worked by one man.

An independent diagonal compound engine, with cylinders of 7½ and 18 ins. by 16 ins., supported on an A-frame, with levers for working a double set of air, circulating, feed and bilge pumps, especially designed by the builders, is fixed at the forward end of the engine room.

The two boilers are of steel, of the gunboat type, each being 7 ft. 10½ ins. in diameter and 16 ft. 3 ins. long, fitted with two Purves ribbed furnaces 3 ft. in diameter and 240 tubes 2¼ ins. in diameter and 6 ft. 9 ins. long. The total heating surface of the two boilers is 2,272 sq. ft., and the working pressure is 160 lbs. A fan 7 ft. in diameter is fitted in the stokehold for forced draft on the closed-ashpit system, should it be required. All the engines in the vessel are fixed in one engine room.

At the "Mersey's trial trip, four runs were made; two with and two against the tide, showing an average speed of 13.06 knots per hour.

The draft at the trial was 3 ft. 10 ins. forward and 7 ft. 4 ins. aft, equivalent to a displacement of 388 tons. The engine showed 978 I. HP. when making 124 revolutions per minute.

The hull of the vessel complete weighs 230 tons. The engines, boilers and water weigh 150 tons. The registered tonnage is 20; the Board of Trade certificate is for 1,214 passengers. The total cost of the two vessels, delivered complete, was £26,000. All the conditions having been fulfilled, the "Wirral" and "Mersey" were put upon their station, and have kept up a ten-minutes' service with admirable regularity since 1891. Not only have the working expenses of the ferry been reduced one-third by the substitution of two for three boats, doing the same work, but a further saving has taken place from the decrease in coal consumption, boat for boat, of 500 lbs. per hour, the new twin-screw boats burning only 600 lbs. per hour.

The tide of traffic on the Woodside ferry has turned again. Passengers, attracted by the speed, comfort and easy motion of the steamers in bad weather, now use the ferry to a greater extent than at any former time, and the corporation of Birkenhead has increased the net income from the ferry nearly £10,000 per annum by the change.

In the discussion of the papers of Messrs. Brown and Jones, Mr. S. W. Barnaby said that Messrs. Thornycroft & Co. had just completed a four-screw passenger steamer for the Hooghly River traffic. With 3 ft. 5 ins. draft and 140 ft. length they had guaranteed a speed of 13 knots per hour with 600 passengers. The stern propellers were screw turbines. The bow propellers had such a pitch that they worked without slip when going at full speed ahead and were only designed to do effective work when starting or when going astern. Dr. W. H. White thought the proposition to build elevating deck steamers for shipping cattle, etc., as proposed, was hardly practicable, as the two vessels in a seaway would have dissimilar motions. Mr. H. Ward said that a ferry was once operated between Rotherhithe and Wapping with the landing stages moved up and down to suit the tide by hydraulic power. Mr. Brown said the bow screws of the "Oxton" were not of much use for propulsion, but were added to give better manoeuvring power.

A CRITICISM OF THE EXPERTS' ESTIMATES OF COST OF A NORTH RIVER BRIDGE.

In a recent letter to Mr. Gustav H. Schwab, Chairman of the Special Committee of the New York Chamber of Commerce on North River Bridges, Mr. W. Hildenbrand, C. E., criticises the comparative estimates submitted by the Board of Expert Engineers reporting upon the proposed Hudson River bridges, referring especially to their figures for weights, condition of loading and price of material. The report was published in our last week's issue. This letter has been submitted by Mr. Schwab to the Secretary of War, and an abstract of its contents will be interesting to engineers.

While Mr. Hildenbrand believes that the Board has considered the question very fairly, he contends that it has liberally increased the weights and put dimensions above what is really sufficient and has assumed more severe conditions for live load and working stresses for the suspension bridge than for the cantilever. The Board itself drew attention to these same facts in its report and acknowledged that the prices it assumes should really be lower. It followed the frequent practice of assuming more severe conditions than actually exist, to be on the safe side, and neglected in the calculations certain favorable circumstances, because it was not figuring upon detailed plans and wished to leave a liberal margin for contingencies. Viewed in the light of the maximum cost of a suspension bridge, no comment would be necessary, says Mr. Hildenbrand, but as a comparative estimate between two structures, one of which was estimated from previous careful and time-absorbing calculations, it is only fair that that structure should have the benefit of all possible accuracy, and acknowledged existing favorable facts should be fully considered.

Mr. Hildenbrand has carried out the calculations

for the suspension bridge, with the modifications suggested in the report, and submits the results to Mr. Schwab. The first feature of the report which he takes up is the assumption that the chords of the stiffening truss would be strained 12,500 lbs. per sq. in. by upward bending and 6,250 lbs. by downward bending, "on the assumption, as before, that all the moving load is distributed by the stiffening truss." But the Board then adds: "As only about 88% is thus distributed, by reason of the unsymmetrical deflection of the cable, the maximum chord stresses are reduced and become respectively 11,000 and 5,500 lbs."

With this acknowledgment before him, Mr. Hildenbrand proceeds to compute the weight of the stiffening truss for the part of the load which it actually distributes, instead of computing it as distributing the entire load, as done in the report, finding as a final result that the 3,200-ft. suspension bridge would cost $32,733,300, or $2,634,000 less than the Board's estimate. The actual live load to be distributed by the stiffening truss is 15,000 lbs. per lin. ft., instead of the imaginary load of 18,000 lbs.

The unit stresses adopted by the Board were 20,000 to 22,500 lbs. per sq. in. in the cantilever and 60,000 lbs. per sq. in. for the suspension cables; or, in both cases, about one-third of the ultimate strength of the metal. But, says the writer, the maximum strain in the cantilever type of bridge may occur with comparative frequency, or whenever six heavy freight trains of 1,000 ft. length each are crossing the bridge together. But the maximum strain in the suspension cable will only occur when 18 such trains are on the bridge at one time, a possibility that may never be realized and that can easily be prevented by proper policing. In the estimate for the lighter suspension structure submitted by the Board, this fact is to some extent acknowledged by assuming a live load of but 9,000 lbs. per lin. ft. in calculating the cables, towers and anchorages; but adhering to 18,000 lbs. per lin. ft. for the stiffening truss and all details. Under this assumption the maximum tension in the cables would occur with nine freight trains, 1,000 ft. long each and weighing 3,000 lbs. to the lin. ft. But this is still 50% greater than the load required for producing the maximum effect in the cantilever bridge, and the reduction made is certainly fair in comparing the two bridges. But if in this lighter structure the stiffening truss be also calculated for 15,600 lbs., instead of 18,000 lbs. per. lin. ft., the price of this 3,200-ft. bridge is reduced to $28,135,600, or only $1,400,000 more than the cost of the 2,000-ft. cantilever bridge.

Mr. Hildenbrand then takes up the subject of reversed strains, and says that the extreme variation of strain on the stiffening truss (occurring at very long intervals of time) is only 18,750 lbs., and not 22,500 lbs. Whatever the opinion of engineers may be in regard to proportioning members exposed to reversed strains, they will agree that reversed strains occurring only at intervals of many years do not affect the metal differently from strains in one direction. He contends, therefore, that for a fully equitable comparison a higher working stress of not less than 15,000 lbs. per sq. in. should have been assumed in the chords and web system of the stiffening truss. Mr. Hildenbrand holds that a working strain of ± 20,000 lbs. per sq. in. would be perfectly safe and proper. "It has proved so in the Niagara railway suspension bridge, with this important distinction, that in that bridge the stiffening trusses are strained to the maximum from almost every train passing over it, or 100 times per day; while the maximum strain in the stiffening trusses of a six-track 3,200-ft. suspension bridge may only occur 'once in a century,' to use the expression of the Board." Assuming, then, a working stress of 15,000 lbs., instead of 12,500 lbs., in the stiffening truss, and calculated for its proper moving load, Mr. Hildenbrand figures that the Board's heavy single-span structure would cost $30,309,500, and the light-structure, single-span 3,200-ft. suspension bridge would cost only $25,704,800, or less than the Board's estimate for the 2,000-ft. cantilever span.

Mr. Hildenbrand next takes up the question of the cost of materials assumed by the Board and quotes from the report as follows: "The majority of the Board believes that this price is too high, owing to the difference in character of steel work in the two structures, and that the total cost of the structural steel work should not be estimated higher than $8,500,000."

From the above Mr. Hildenbrand considers that the correct price of the steel work of the suspension bridge would be 4.116 cts. per lb., and not 4½ cts. The board also estimates the cost of the wirework to be 8 cts. per lb. The writer says that this is correct for the suspenders, but is too high for the cables. "At present prices for wire, and in the light of past experience, the actual cost of the cables will not exceed 6½ cts. per lb., and the firm of John A. Roebling's Sons have offered to take the contract at 7 cts., or at the most 7¼ cts., per lb." If these corrections are made in the cost of the wirework and structural steel, assuming a price of 7½ cts. per lb. for the wire and 4.116 cts. for the steel work, the price of the suspension bridge would be again reduced. Mr. Hildenbrand submits his final results for comparative purposes as follows:

1. Heavy structure suspension bridge of 3,200 ft. span; 18,000 lbs. per lin. ft. moving load; maximum strains in stiffening truss, ± 12,500 lbs.; calculated for 15,600 lbs. per lin. ft.; cost of structural steel work, 4.116 cts., and of cablework, 7½ cts. per lb.; estimated cost of bridge, $31,651,300.

2. Lighter structure suspension bridge of 3,200 ft. span, 9,000 lbs. per lin. ft. moving load; maximum strains in stiffening truss, ± 12,500 lbs.; calculated for 15,600 lbs. per lin. ft.; same price as above; estimated cost of bridge, $27,179,600.

3. Heavy structure suspension bridge of 3,200 ft. span; 18,000 lbs. per lin. ft. moving load; maximum strains in stiffening truss, ± 15,000 lbs.; calculated for 15,600 lbs. per lin. ft.; cost of material same as above; estimated cost of bridge, $29,325,000.

4. Lighter structure suspension bridge of 3,200 ft. span; 9,000 lbs. moving load; maximum strains in stiffening truss, ± 15,000 lbs. per sq. in.; calculated for 15,600 lbs. per lin. ft.; cost of material same as above; estimated cost of bridge, $24,846,000.

Mr. Hildenbrand thus contends that with but slight modifications in the original assumptions the heaviest single-span 3,200-ft. suspension bridge would cost only $2,600,000 more than the 2,000-ft. cantilever, and a lighter 3,200-ft. span suspension bridge, "fully safe and practicable," could be built for $2,000,000 less than the 2,000-ft. cantilever bridge. The method of anchoring the cables suggested by the Board is unobjectionable as regards strength and durability, but it is expensive, says the writer, and he thinks these cables could be safely imbedded in cement and masonry and the anchorage could be thus cheapened over the tunnel plan.

PERSONALS.

Mr. Emil Goldstein has been elected City Engineer of Johnstown, Pa.

Mr. James Douglas, architect, of Milwaukee, Wis., died Aug. 31. He was born in Wick, Scotland, in 1823.

Col. A. Wildes, a member of the Maine Railroad Commission, died at Skowhegan, Me., Sept. 3, at the age of 70.

Mr. Edward Cummings, one of the principal contractors on the Cincinnati Southern Ry., died at Cincinnati, O., Aug. 31.

Mr. George C. Smith, formerly Assistant General Manager of the Missouri Pacific Ry., has been appointed President and General Manager of the Western Ry. of Alabama.

Mr. D. W. Caldwell, President of the New York, Chicago & St. Louis Ry., has been elected General Manager of the Lake Shore & Michigan Southern Ry., to succeed the late John Newell.

Mr. Harry L. Weber, who has been county surveyor of Crawford county, and City Engineer of Bucyrus, O., has tendered his resignation from the latter position, and has accepted the position of City Engineer of Richmond, Ind.

Mr. J. M. Barr, who recently resigned as Division Superintendent of the Chicago, Milwaukee & St. Paul Ry., has been appointed Superintendent of the Breckenridge Division of the Great Northern Ry., with headquarters at Willmar, So. Dak.

Mr. Josiah P. Coake, professor of mineralogy and chemistry at Harvard University, died at Newport, R. I., Sept. 3. He was born at Boston in 1827, graduated at Harvard in 1848, and in 1851 was appointed Ewing professor of mineralogy and chemistry in that institution.

M. D. W. Lum, formerly Chief Engineer of the East Tennessee, Virginia & Georgia Ry. (now included in the newly organized Southern Ry.), has been appointed General Roadmaster of the Western System of the Southern Ry., in charge of the maintenance of roadway and structures, with offices at Knoxville, Tenn.

The Massachusetts State Board of Health has moved its offices from 13 Beacon St., Boston, to the new addition to the State House. This changes the headquarters of Messrs. F. P. Stearns, Chief Engineer; Albert F. Noyes, Assistant Chief Engineer, and X. H. Goodnough and W. W. Locke, Assistant Engineers. Their address is now Room 140, State House, Boston, Mass.

Mr. Frank C. Osborn, M. Am. Soc. C. E., and Mr. A. Lincoln Hyde, Assoc. M. Am. Soc. C. E., have formed a partnership under the name of The Osborn Co., with headquarters at Cleveland, O. Mr. Osborn, the senior member of the firm, has been engaged for many years in general engineering practice and is well known to the profession through his tables for calculating moments of inertia, etc. Mr. Hyde has been engaged in bridge work for the past eight years, being until recently Principal Assistant Engineer of the King Bridge Co., of Cleveland, O. The firm will make a specialty of bridges and structural ironwork.

Mr. Henry Faija, M. Inst. C. E., well known as an expert in all that pertains to hydraulic cement, died in England on Aug. 21. Mr. Faija was the son of Mr. G. Faija, a miniature painter to the Queen of England, and was born in London in 1844. He was educated at University College School and was first articled to a firm of shipbuilders of the Isle of Dogs. He was later with a shipbuilding firm on the Tyne, and after a brief partnership with an engineering firm at Stoke-on-Trent, he went to London in 1870, and opened an office as a practicing engineer. Among his early commissions was one to design and erect cement works, and he was thus led to realize that a vast field existed for improvement in this industry, and he from that time forward devoted himself to its development. In 1880 he established a cement-testing and chemical laboratory and made many tests and reports upon this material, having a very large practice as an expert. Mr. Faija contributed a number of articles to various technical societies, and in 1881 published a treatise on "Portland Cement for Users." He devised his own testing apparatus and his recorded results in this direction are said to far exceed those of any other investigator into the properties of hydraulic cements.

NEW PUBLICATIONS.

SEPTEMER MAGAZINES.—In the "Review of Reviews" we find a paper which should be read by every one interested in the currency question. It is the statement prepared by the bimetallist members of the German Silver Commission, setting forth the reasons which lead them to urge international bimetallism as the only safe plan of adjusting the currency question for the civilized world. Other papers in this number deserving mention here discuss methods of taxation in Australia and Japanese progress and politics. In Harper's," Dr. T. M. Prudden, the bacteriologist, tells of "Some Records of the Ice Age about New York." One interesting fact that may not be generally known is that the channel of the Hudson has been traced from a point about ten miles northeast of Sandy Hook across the submarine plateau which borders the continent, and that it forms a deep chasm some 25 miles in length, 1¼ miles wide, and in places 2,000 ft. in depth below its submerged edges, themselves far beneath the ocean's surface.

In the "Forum," Edward Atkinson has a thoughtful paper on "Present Industrial Problems in the Light of History," and Mr. Jacob A. Riis discusses the subject of state and municipal labor exchanges under the title "How to Bring Work and Workers Together." Another interesting sociological paper by Mr. J. H. Gore, U. S. Commissioner-General to the Antwerp Exposition, describes the profit-sharing labor unions of Antwerp. In the "North American Review," Mr. Hiram L. Maxim gives a summary of his experiments in aerial navigation, concluding with the accident of July 31, described in our issue of Aug. 31. Mr. Maxim takes a very sanguine view of his experiments and of the results to be hoped for from them, and concludes as follows:

> It now only remains to continue the experiments with a view of learning the art of manoeuvring the machine; and for this purpose it will be necessary for me to seek some large open and level plain and to commence by making flights so near to the ground that any mistake in the steering cannot result in a serious mishap.

In "McClure's" we find an interesting paper discussing the theory of Professor Berthelot, that chemistry

is destined to replace agriculture in the production of many of the staple articles of food. Another article of considerable interest describes the famous experiments of Otto Lilienthal on flying machines. The results of irrigation in Colorado and the "Great American Desert," generally, are described in a fully illustrated paper by Cy. Warman.

In "Scribner's" Mr. Herbert Laws Webb, M. Inst. Elec. E., tries his hand at story writing, and tells a very good anecdote of the life of a cable operator at a lonely station on the South American coast. "The Century" contains an account by Joseph B. Bishop of the manner in which corporations in the state of New York are assessed for the benefit of political parties and politicians. Mr. Bishop says that the most conservative estimates place the total amount of blackmail thus collected in New York city at $2,000,000 to $4,000,000. "Color at the Far North" is the title of a paper by F. W. Stokes, the artist who accompanied the Peary relief expedition of 1892.

TRADE PUBLICATIONS.

SEMAPHORE SIGNALS. The Eclipse Co., Beaver Falls, Pa. 8vo; pp. 16; illustrated.

The switch and signal department of the company makes a specialty of the Abernethy three-position semaphore, which is available as a train order or block signal, and has the unusual feature that the colored glasses are not carried in the end of the blade, and so are not liable to be broken by the jar of the signal when operated. The cast iron arm which holds the blade is so shaped that the blade lies in a vertical position when indicating "track clear." There are two arms on the post, one governing each direction of movement. The normal position is at "danger," and in any other position an electric bell is kept ringing in the operator's office. Hollow steel poles of octagonal form are used, the lantern being run up inside the pole. The company also makes an automatic switchstand, and an interlocking track crossing plant, which requires the operator to put the home and distant signals of one track at danger before he can show a clear signal for the other track, and he cannot show the latter if a train has passed the distant signal on the first line.

SOCIETY PROCEEDINGS.

NATIONAL IRRIGATION CONGRESS.—The third annual irrigation congress opened at Denver on Sept. 3 and continued throughout the week. A comparatively small part of the proceedings of the first three or four days were of engineering interest.

Mr. Elwood Mead, State Engineer of Wyoming, was chosen president, and Mr. Thomas L. Smith, of Colorado, secretary of the congress. The Wright Irrigation District Law was discussed by Mr. L. M. Holt, of California. Mr. J. W. Gregory stated that irrigation was a necessity in 52 counties in Kansas and that $3,000,000 had already been invested in irrigation in Western Kansas. Mr. W. W. Fallett, of Denver, read a paper on "The Underflow of the Waters of the Great Plains," and Mr. Robert Hay, State Geologist of Kansas, read a paper on "Waters of the Plains." Mr. Fallett thought that the underflow of Colorado and Kansas was from surface streams rather than directly from mountain snow and rain. Mr. Hay believed that irrigation from surface streams could be practiced only on a small scale in Kansas, but that in most places in the valleys the underflow was near enough to the surface to admit of raising large crops of alfalfa by its aid.

A paper on "Ancient and Modern Irrigation Methods in China and Japan" was read by Mrs. M. A. Hamm-Fales. The paper was very interesting, but its chief point of instruction for Americans was to waste nothing. Capt. W. G. Glassford, U. S. A., read a paper on "Meteorological Factors and Climate Constants of Arid America."

Excursions were taken during the week to visit irrigated sections near Denver. Albuquerque, N. M., was chosen as the place for holding the next annual meeting.

CENTRAL RAILWAY CLUB.—The next meeting will be held at the Iroquois Hotel, Buffalo, at 10 a. m. on Wednesday, Sept. 26. The paper by Supt. J. B. Morford, of the Michigan Central, on "Terminal Yards" will be discussed and committees will report on the subjects of locomotive driving boxes and the maintenance of passenger equipment by running repairs.

S. W. Spear, Secy.

AMERICAN ROADMASTERS' ASSOCIATION.—The annual convention of the association was held in New York city Sept. 11, 12 and 13. The opening meeting on Tuesday morning was held in Tammany Hall, where the delegates were made welcome in a brief speech by Mr. Geo. B. McClellan, President of the Board of Aldermen. Col. H. S. Haines, President of the American Railway Association, addressed the members, referring to the importance of track and its maintenance in connection with modern locomotive weights and high train speeds, and referring also to the necessity for and advantages of signal and interlocking plant in securing increased safety and facility in handling heavy traffic on the road and in large yards. Brief remarks were also made by Mr. H. W. Reed, president of the association, and Mr. W. W. Sharpe presented his reports as secretary and treasurer.

At the afternoon meeting at the headquarters in the Broadway Central Hotel, a statement of the proceedings taken to incorporate the association under the laws of Illinois was made by Mr. W. H. Stearns, of the sub-committee appointed for this work. The erection of officers was then proceeded with, and resulted as follows: President, Robert Black (Manhattan Ry.); First Vice-President, C. E. Jones (C., B. & Q. R. R.); Second Vice-President, J. A. Kerwin (Chicago & Northwestern Ry.); Secretary and Treasurer, W. W. Sharpe (Savannah, Florida & Western Ry.); Members of Executive Committee, G. W. Bishop (Fitchburg R. R.) and G. W. Merrill (Chicago, Milwaukee & St. Paul Ry.).

The following committee report was then read:

Records and Reports of the Maintenance of Way Department.—1. Maintenance of way blank forms used on railways should be made up so as to suit the organization and the system of accounts in use on each road; consequently no special recommendation can be given as to their number or details.

2. It is thought that the maintenance of way blank forms on many roads may be more complicated than necessary to secure the end desired and often the forms as used secure duplicate or insufficient information. It is, therefore, recommended that the heads of the maintenance of way departments take up this question on their respective roads.

3. Your committee regards the following information and forms as generally necessary for a proper record of the maintenance of way department of any railway, and for securing the proper charges; (a) A daily record of each trackman's work on a sub-division or on a work train, so that his time can be charged to the proper account; (b) A daily record of material used on each track foreman's sub-division; (c) A daily record of materials handled by work trains; (d) A track foreman's monthly report of work done and materials used and on hand on his sub-division; (e) A work train foreman's monthly report of work done; (f) A foreman carpenter's monthly report of all materials used and on hand and work done; (g) A monthly report by track foremen, work train foremen and foremen carpenters of tools on hand; (h) A supervisor's or roadmaster's monthly report of all materials used and on hand and giving the distribution; (i) A supervisor's or roadmaster's report of periodical inventories of materials on hand; (j) A track foreman's and supervisor's or roadmaster's report of fires along right of way; (k) A track foreman's and supervisor's or roadmaster's report of stock killed; (l) A track foreman's and a supervisor's or roadmaster's report of broken rails; (m) A supervisor's or roadmaster's report of scrap for sale; (n) Statement covering shipment of rail and other maintenance of way or construction material; (o) A supervisor's or roadmaster's report of track laid or changed.

4. Your committee recommends the use of concise and carefully prepared printed forms for securing all classes of maintenance of way information. The data secured by the use of these can be readily compiled in proper record books or blanks in the chief office of the maintenance of way department.

Chas. S. Churchill, Chairman; R. C. Sattley, M. J. McInarna, Geo. M. Brown, W. H. Stearns.

This report was, on motion, adopted without discussion, which was certainly bad practice, indicative of carelessness in the proceedings. The inexpediency of such hasty action was, however, pointed out by some members and the matter was reconsidered, with the result that the report was sent back to the committee with instructions to present at the next annual meeting suitable forms to be used for the records recommended.

The other reports and discussions, with notes on the exhibits of railway supplies and appliances will be given next week.

MASTER CAR BUILDERS' ASSOCIATION.—The following are the subjects to be reported on at the next convention, to be held in June, 1895, with the committees to which they are assigned:

Interchange of Cars.—To suggest how cars in interchange may be maintained equitably to owners and operators with the least expense and detention. Pulaski Leeds, J. N. Barr, Samuel Irvin, J. W. Marden, E. D. Nelson, J. H. Rankin, L. Packard.

Road Tests of Brake Shoes.—To conduct and report upon a series of comparative tests of different brake shoes in service. R. H. Soule, A. E. Mitchell, Jos. Townsend, W. S. Morris, W. H. Lewis, Sam'l Porcher, S. A. Crone, J. W. Marden, J. C. Barber, G. W. Rhodes, A. M. Waitt, W. L. Hoffecker.

Laboratory Tests of Metal for Brake Shoes.—To conduct and report upon laboratory tests of different brake shoes. S. P. Bush, D. L. Barnes, J. W. Cloud.

Lubrication of Cars.—Continued from 1894 to pursue its own recommendations as to tests of oil for lubrication, and to consider the economics of journal bearings as suggested in its report, if feasible. A. M. Waitt, W. H. Thomas, I. E. Wood, F. A. Stinard, W. K. Carr.

Air-Brake Tests.—G. W. Rhodes, George Gibbs, E. A. Williams, S. P. Bush, A. S. Vogt.

Air-Brake and Hand-Brake Apparatus on Cars.—E. D. Bronner, Pulaski Leeds, Jas. McGee, Wm. McWood, W. P. Siddons.

Automatic Couplers.—To advise what changes may be desirable in the standard size of M. C. B. automatic coupler shanks, and to recommend a standard yoke or pocket strap for rear end attachment to cars. J. M. Wallis, R. D. Wade, T. G. Duncan, A. E. Mitchell, William Garstang, Thomas Kearsley, J. T. Chamberlain.

Mounting New and Second-Hand Wheels.—To report upon the best method for mounting new and second-hand wheels so that they shall be properly located upon the axle. J. N. Barr, William Forsyth, Thomas Sutherland, G. L. Potter, T. J. Hatswell, John Hodge, J. H. McConnell.

Passenger Car Ends and Platforms.—To consider what improvements may be made in the construction of passenger car ends and platforms for increased strength in ordinary service and in emergencies. E. W. Grieves, C. A. Schroyer, T. A. Bissell, F. D. Adams, M. M. Martin, J. J. Hennessey, Samuel Porcher.

Coal Car Sides.—To suggest best methods of construction and staying of the sides of 60,000-lb. coal cars with high sides. R. E. Marshall, R. P. C. Sanderson, R. C. Blackall, R. McKenna, Samuel Higgins, La Mott Ames, G. W. West. Jno. W. Cloud, Secy

COMING TECHNICAL MEETINGS.

ROADMASTERS' ASSOCIATION OF AMERICA.
Sept. 11, 12, 13. New York. Secy., W. W. Sharpe, Waycross, Ga.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Sept. 14. Secy., D. W. Meeker, St. Paul, Minn.
ENGINEERS' CLUB OF MINNEAPOLIS.
Sept. 17. Secy., E. Nexsen, Kasota Block.
WESTERN RAILWAY CLUB.
Sept. 18. Secy., C. F. Street, Rookery Building.
COLUMBIAN ENGINEERING SOCIETY.
Sept. 18. Secy., F. W. Hart, Washington, D. C.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Sept. 19. Secy., Francis Collingwood, 127 E. 23d St., N. Y.
COMMISSIONERS OF PUBLIC WORKS.
Sept. 19. Buffalo, N. Y. M. J. Murphy, St. Louis, Mo.
ENGINEERS' CLUB OF ST. LOUIS.
Sept. 19. "Sharp Curves in Railway Yards." Secy., W. H. Bryan, Turner Block.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Sept. 19. Secy., J. A. Pilcher, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Sept. 19. Secy., S. E. Tinkham, 36 Bromfield St.
CENTRAL RAILWAY CLUB.
Sept. 26. Secy., S. W Spear, East Buffalo Iron Works, Buffalo, N. Y.
ENGINEERS' CLUB OF CINCINNATI.
Sept. 20. Secy., J. F. Wilson, 24 W. 4th St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Sept. 20. Secy, D. Carhart, Carnegie Library Building, Pittsburg.
NEW YORK RAILROAD CLUB.
Sept. 20. Secy., John A. Hill, Temple Court, N. Y. City.
ENGINEERS' CLUB OF INDIANAPOLIS.
Sept. 22. Secy., C. C. Brown.
AMERICAN PUBLIC HEALTH ASSOCIATION.
Sept. 25 to 28. Montreal, P. Q. Secy., Dr. Irving A. Watson, Concord, N. H.
DENVER SOCIETY OF CIVIL ENGINEERS.
Sept. 27. Secy., F. Ed. King, 36 Jacobson Block.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Oct. 1. Secy., C. L. Annan, City Engineer's Office.
AMERICAN INSTITUTE OF MINING ENGINEERS.
Oct. 2 to 6. Bridgeport, Conn. Secy., R. W. Raymond, New York.
WESTERN SOCIETY OF ENGINEERS.
Oct. 3. Secy., Thomas Appleton, Lakeside Bldg. Chicago.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Oct. 5. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
Oct. 6. Secy., L. F. Rondinella, 1122 Girard St.
WISCONSIN POLYTECHNIC SOCIETY.
Oct. 8. Secy., Geo. G. Mason, 144 8th St., Milwaukee.
ENGINEERS' CLUB OF KANSAS CITY.
Oct. 8. Secy., Waterman Stove, Baird Building.
NORTHWEST RAILWAY CLUB.
Oct. 9. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Oct. 9. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Oct. 9, 11. Secy., F. C. Osborn, 721 Hickox Building.
NEW ENGLAND RAILROAD CLUB.
Oct. 10. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
ENGINEERS & ARCHITECTS' CLUB OF LOUISVILLE.
Oct. 11. Secy., G. W. Shaw, Norton Building.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Oct. 11. Secy., C. H. McLeod, 112 Mansfield St. Montreal.
ENGINEERING ASSOCIATION OF THE SOUTH.
Oct. 11. Hunter McDonald, Nashville, Tenn.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Oct. 12. Secy., G. O. Foss, Helena, Mont.
ASSOC. SUPERINTENDENTS OF BRIDGES & BUILDING.
Oct. 16. Kansas City, Mo. Secy., S. F. Patterson, Concord, N. H.
AMERICAN STREET RAILWAY ASSOCIATION.
Oct. 17. Atlanta, Ga. Secy., Wm. J. Richardson, Brooklyn, N. Y.
AMER. SOCIETY OF RAILWAY SUPERINTENDENTS.
Oct. 20. New York. Secy., G. A. Hammond, Boston.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 15. Atlanta, Ga. Secy., F. A. Charlot, Macon, Ga.
SOCIETY NAVAL ARCHITECTS & MARINE ENGINEERS.
Nov. 15 and 16. Annual Convention in New York city. Secy., W. L. Capps, U. S. N., Washington, D. C.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 3 to 7. Secy., F. R. Hutton, 12 W. 31st St., New York.

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

Finding suitable subjects for theses will be a task exercising the minds of students in the graduating classes and of their teachers in most American engineering schools during the next few months. We have reason to believe that there is occasionally a difficulty found in selecting subjects suitable for original investigation in the preparation of theses; and this leads us to suggest that any of our readers who may have in mind problems suitable for such investigations will doubtless confer a favor on both professors and pupils by stating them through our correspondence columns. We have several times alluded to the high grade of work which is shown in the best graduating theses of our technical schools; and there is no reason why the great amount of original investigation carried on by these advanced students should not be made to yield a considerable harvest of useful knowledge.

It is all very well to say that truth is to be pursued for its own sake, and that the researches of science should not be bound down by any regard for their results in dollars and cents. On the other hand, engineering schools do not exist for the purpose of training scientists or physicists, but engineers; and if a student is put to work at original investigations, he should, if possible, attempt to solve some problem of a practical character, the solution of which will fit him in some degree at least for undertaking original investigations in his professional work in after years.

As a starter in the way of suggestions for thesis investigations we would describe two problems which have recently been brought to our notice, and the solution of which has, so far as we know, never been made, or, at least, has never been placed on record. The first question is: To what extent does the influence of increased pressure in raising the boiling point affect the formation of steam in the lower portions of a steam boiler? In the common horizontal water-tube boiler, for example, the water in the lower part of the boiler may be under a pressure, perhaps, 4 to 5 lbs. greater than the pressure at the water line. In a boiler with free circulation there is a rapid flow of water from the separating drum down the rear headers, through the tubes and up the front headers. This rapid circulation tends to keep the water in all parts of the boiler at the same temperature, and the question is, how rapid a circulation is required in such a boiler to keep the lower tubes, exposed directly to the fire, full of solid water. An experimental apparatus with a riser of glass could easily be devised to study this question and obtain results with various rates of circulation and various rates of evaporation. The results might teach some useful lessons respecting the design of many types of boilers besides the type to which we have referred for illustration.

The second question is much more difficult of investigation, but its solution may possibly be of very great practical importance. As is well known, the numerous inventors of contrivances for smoke prevention, which operate by blowing in steam over the fire, have been accustomed to dignify their appliances by calling them fuel gas generators, claiming that the steam blown over the fire operates in somewhat the same fashion as if it were blown through the incandescent fuel. Engineers have generally paid little attention to this claim, however, holding that, even if it were true, it was of no practical importance, since complete combustion of the hydrogen and carbon in the fuel gives the same total amount of heat, regardless of what intermediate changes are passed through in the combustion process. But, on the other hand, the claim has recently been made that the effect of steam in the combustion chamber is to promote complete combustion by facilitating combination between the oxygen and the carbon or the hydrogen. We are not aware that any experiments have ever been made to test the truth of this claim, yet there is some reason to believe that it may have correct formations. It is known that an explosive mixture of oxygen and hydrogen requires the presence of moisture as well as heat to effect its combination. Again, it is popularly believed, in regions where wood is the principal household fuel, that green wood makes a hotter fire than dry when once fairly burning. Our knowledge of the chemical action accompanying combustion is too incomplete to enable us to make positive statements in reference to all its features and the question whether steam blown over the fire causes waste or economy is one well worth a thorough investigation.

It will probably surprise many of our Northern readers at least, to know that in Louisville, Ky., civil engineers are required to take out a license in order to do business. The constitution of Kentucky, like that of many other Southern states, permits towns and cities to require licenses from those engaged in various trades and occupations, and a few months ago the General Council of Louisville ordained, in the exercise of its wisdom, that every civil engineer practising his profession in that city must pay an annual license tax of $10. In case civil engineers are associated in a firm or corporation, each member of the firm must pay a separate license tax. To one accustomed to methods of taxation common in the North, where licenses are usually required only for drinking saloons, concert halls, pawnshops, and, in general, for occupations which require some public supervision to prevent them from being improperly conducted, it seems like a slur on the profession to require licenses from those who follow the innocuous profession of civil engineering; but in several Southern states the old-time custom of raising revenue by laying a license tax upon those who follow many special occupations is still kept up. One would suppose, however, that the enforcement of the law would give rise to some interesting questions, which have puzzled wiser people than the tax authorities of Louisville. Where is the line to be drawn between the civil engineer and the mechanical engineer; or suppose a man chooses to call himself simply an engineer, can he thus avoid the tax? Again, is the land surveyor a civil engineer, and does the engineer who is employed on a salary "practise" his profession?

Another unique idea which has been recently put in force in Louisville is the requirement that candidates for the office of city engineer must take an examination before a board, in which they must obtain a marking of at least 80. The Board of Examiners for the current year consisted of Messrs. H. P. McDonald, A. H. Barrett and C. L. Cornwell. The examination was one which would puzzle many an engineer of much experience. Evidently the city authorities of Louisville are determined that the civil engineers among them shall not think of themselves more highly than they ought to think.

In its last annual report the Interstate Commerce Commission devoted considerable space to noting the present tendency among railway corporations to unite scattered interests under a single controlling head, rather than to extend existing lines by new construction. One of the latest and most important moves in this direction is the successful reorganization of the Richmond Terminal system, now definitely and formally completed. Its successor is the Southern Railway Company, operating 4,500 miles of railway and about 150 miles of waterway. With the exception of a leased line of 491 miles, this system is now owned by the new company, and a heretofore complicated, very expensive and utterly unsatisfactory plan of control by majorities is done away with. The old Richmond Terminal Company owned only 145 miles of railway, and the so-called Richmond & Danville system was made up of about thirty separate companies, owning from 6 to 552 miles of road each. Under the old plan of operation efficiency and economy were impossible; the systems of accounting were objectionable, the fixed charges great and the revenue for maintenance and improvement of the road utterly insufficient. Under the reorganization plan thirty boards of directors and thirty sets of separate accounts have disappeared; a bonded and floating debt of $135,000,000 has been reduced to $94,000,000, and an arrangement has been made to issue another $6,000,000 of bonds in the next two years, with which to purchase new material and make badly needed improvements. The plan also provides for the issue of $20,000,000 more bonds, within a certain series of years, for the further development of the property. The fixed charges are reduced from about $7,500,000 per annum, with about $700,000 per annum for a sinking fund in addition, to $4,100,000 in 1894, $4,700,000 in 1895, and $5,400,000 in 1896. This is a most happy consummation of effort to those interested in these many roads, and converts into a new and propitious enterprise what was before a most unfortunate and awkward entanglement of interests. It is one of the most notable events in late railway history and should have a beneficial effect in encouraging other should have a beneficial effect in encouraging those in charge of the reorganization of other large railway systems.

Our attention is called to the fact that in the article on "Tests of Material for Fireproofing Columns," in our last issue, an error was made in translating a certain paragraph. The paragraph referred to was as follows:

> It is thus proved by this test that ordinary brick masonry, one-half as thick as would have been required for stone masonry, was capable of entirely protecting the wrought iron columns during the 2½ hours through which the fire lasted.

Properly translated, this should read: "It is thus proved by this test that ordinary brick masonry of half stone thickness was capable," etc. The expression "one stone," or "half-stone," does not here refer to the material, but to a standard Austrian dimension for masonry. One stone is 32 cm. and a half stone is 16 cm., or about 6⅓ ins. In justice to our translator we would say that the error was made in this office, by an editor who had never heard the words "half stone" used as a dimension, and changed the form of what seemed to him a sentence of doubtful meaning.

THE PROPOSED SHIP CANAL ACROSS NEW JERSEY.

In discussing the various projects for ship canals in America, in our issue of June 28, we said of the proposed ship canal across New Jersey:

> It is urged as a strong point in favor of this canal that it would save time and expense to vessels entering and leaving Philadelphia, as compared with the present outlet to the sea via the Delaware River and Bay; but as the canal would be 34 miles in length, on making reasonable estimates for comparative speed in the canal and in open water, it is difficult to see how the time of transit would be sufficiently lessened by the proposed canal to attract a very heavy traffic.

Prof. L. M. Haupt, who has been active in the promotion of this scheme for some years, has written us a letter of considerable length, setting forth the reasons why he thinks the proposed canal would be a commercial success. Certainly nothing is further from the aims and desires of this journal than to throw cold water on any sound and meritorious engineering project. At the same time we believe it to be for the interest of the public, and especially of the engineering profession, that no engineering enterprise shall be undertaken which cannot be

made, in some reasonable degree, a commercial success. To that end it is greatly to be desired that, prior to the undertaking of any important engineering work, the fullest facts and figures should be obtained to form the foundation for an accurate estimate of the prospects of the enterprise. We, therefore, cheerfully give space to Professor Haupt's letter, which is as follows:

Sir: Concerning that link of the Atlantic coast system which would cross New Jersey by a canal 34 miles in length, Engineering News seems skeptical as to its economy in time and traffic. If so intelligent and progressive an engineering periodical has any doubt as to its utility, certainly the layman or the more timid capitalist may reasonably withhold his support. I beg leave to submit, therefore, a few reflections on this head.

1. The ratio of rates by ocean, as compared with rail, is about as one to eight, the average rail rate being 9.6 mills per ton-mile. You state the cost of freight in bulk as low as 4 mills. This is true, but it is the lowest rate and barely pays even on large movements. Cut it in half and still it would leave a large margin on the ship-canal rate.

2. Every mile saved is an economy and tends to cheapen cost of movement by the product of the rate by the quantity.

3. The actual steamer time from Philadelphia to New York is from 24 to 26 hours; by the canal it would be but 12, thus saving at least 50% in time, which is the measure of the economy of the project. This should almost double the earning capacity of the vessel.

4. The saving of distance is 68%, while the risks would be greatly reduced, the losses last year on the Middle Bay (Cape Cod to Hatteras) being over $1,100,000 in value, or 29% of the property risked.

5. The present commerce on the waters between Long Island Sound and Chesapeake Bay aggregates about 60,000,000 tons, and under the above conditions it is safe to assume that on the completion of these two canals not less than 10,000,000 tons would seek the interior, safer and shorter route. The coal to Eastern ports from Philadelphia alone would probably exceed 3,000,000 tons. The present water rate is quoted at 90 cts. to New York. If the canal charged but 60, the revenue on the above tonnage would be $6,000,000, an ample sum to cover every possible contingency in cost of construction and maintenance, even if divided by two.

6. These rates are but 66% of those now existing, and the service would be more expeditious even than by rail, because of time lost in drilling trains and at terminals. Goods shipped at either New York or Philadelphia in the evening could be at the other end by morning.

7. Such a canal would lie along the highway of trade between two of the most populous centers of the world.

8. The average speed is, say, 10 miles per hour by the present outside route. The saving being 12 hours in time, would be equivalent to 120 miles. If the rate be taken at only 2 mills, or half the lowest rail rate, the economy per ton on the trip (one way) would be 24 cts. On a traffic of ten million tons the economy would be $2,400,000 per annum. What could we not afford to pay for a waterway that would effect such a saving each year?

9. France has spent over $700,000,000 on her waterways, and it is stated by her economists that, although they are free, they are worth over 5% on this enormous sum to the country in the resulting economies. This would seem to be substantiated by the facility with which she has paid her enormous indemnity and recouped herself from the devastation of war.

Professor Haupt speaks as the friend and promoter of the enterprise. In order that both sides of the case may be represented, we will briefly state what appear to be the chief objections to the several arguments presented above, taking them up in the order presented:

1. Professor Haupt puts the average freight rate at 9.6 mills per ton-mile; but he should revise his figures by the latest statistics. The average freight receipts per ton-mile for the whole United States in the year ending June 30, 1892, according to the Interstate Commerce Commission's statistics, was 0.898 ct. The average cost of carrying freight traffic in that year, by the same authority, was only 0.582 ct. In the Middle States the average freight rate was only .674 ct. per ton-mile, and the cost of handling the traffic only .470 ct. per ton-mile.* But these figures are the average for all classes of freight, and no one pretends that canals can compete with railways, except in handling the cheapest class of bulk freights, such as coal, ore, grain, lumber, quarry products and the like. We can get some idea of how cheaply such goods can be handled by a modern railway by taking the ton-mile figures for some railways where this class of freight forms the bulk of the traffic. For example, the Fall Brook Coal Company's Ry., notwithstanding its location in the mountains of Northern Pennsylvania, charged only 0.456 ct. per ton-mile in the year ending June 30, 1892, and handled the traffic at a cost of only 0.289 ct. For the Beech Creek R. R., in the same region, the figures were 0.447 ct. and 0.225 ct. Going further west, the average revenues and expenses on all classes of freight for some large systems are as follows:

Road.	Revenue, per ton-mile, ct.	Cost, per ton-mile, ct.
B. & O. lines (West of Ohio River)	0.542	0.417
Chicago & Grand Trunk	0.593	0.394
N. Y., Chicago & St. Louis	0.537	0.438
N. Y., L. E. & W. (W. of Salamanca)	0.581	0.410
Pennsylvania Co.	0.686	0.453

These represent the average earnings on all freight, and of course show that the rates and cost of moving the cheap classes of bulk freight must be much lower. Substantially the same figures can be found in Poor's Manual or in the reports of the railway companies.

Further, even these figures by no means represent the lowest limit of the cost at which bulk freight can be moved on a railway with light grades, provided the volume to be moved is such that modern powerful freight locomotives, hauling modern large-capacity cars fully loaded, can be put at the work.

It may be said that the figures given above for cost of freight movement do not include the interest on capital invested in the plant. This is true, and we would strongly advise any one who proposes to compete with an American railway for traffic not to include the interest on capital invested in computing the cost of rail traffic. The reason is simple enough. It is the additional traffic that pays profits, is a familiar maxim in railway traffic departments; and the limit at which it ceases to pay better to take freight than leave it, is not reached until the rate per ton-mile charged equals the actual operating expenses per ton-mile.

Professor Haupt says that the ratio of rates by ocean to rates by rail is about as 1 to 8. We are unable to see that this is pertinent to the question at issue. The freight rates per ton-mile for an ocean voyage are always far lower than for a short run along the coast, and with much reason, since the loading and unloading occupy so much larger proportion of the time. And the rate at which freight can be moved through any artificial waterway must always be far higher than the cost of moving it on the open ocean, where full speed can be made and where there are no tolls to be paid and no expense for towing.

2. "Every mile saved is an economy," says Professor Haupt. This is arguing on the assumption that a mile of canal navigation is equivalent to a mile of ocean navigation, which is far from being the case. We take it that, leaving to one side the tolls and the cost of towing, any shipmaster would rather go three miles in open water than one mile in a canal. We speak, of course, of ocean-going sail and steam craft.

3. The distance from New York to Philadelphia by the present water route is, roughly, 260 miles. If speed is really so important, the distance could be made, of course, in very much less time than 24 hours. As for the time of 12 hours to make the journey of some 80 miles by the canal route, including navigation of the Delaware River from Philadelphia to Bordentown and of 34 miles of canal, with numerous locks, and with unknown delays at passing points, etc.—we would not be willing to accept this figure without a more detailed examination. Even if the canal saved 50% of the time of transit, however, as Professor Haupt claims, the earning power of a vessel would be far from being doubled. That would only be true on the supposition that no time was consumed in loading and unloading; and for short voyages, as every one knows, the time occupied in this way is a large part of the time that the vessel spends in service.

4. We are astonished, to put it mildly, at Professor Haupt's claim that 29% of the property risked between Cape Cod and Cape Hatteras was lost last year. That is a record of disaster by sea rivalling the losses of the Merchant of Venice. As a matter of interest in this connection, we print the following table from "Mulhall's Dictionary of Statistics":

Percentage of Vessels Lost Yearly and Average Life of Shipping Under Various Flags.

Nation.	Annual loss, —per cent.— Steam.	Sail.	Years of a ship's life.
American	4.06	5.45	18
French	2.47	4.04	20
Dutch	3.84	4.49	22
German	2.77	4.04	25
British	2.94	3.03	26
Italian	1.74	2.94	28
Scandanavian	1.96	3.20	30

Comparing the above with the 29% claimed by Professor Haupt, it looks as if there was a mistake somewhere. In fact, if we rightly understand the matter, the dangers to shipping in a canal or any contracted inland waterway are as great or greater than on the open ocean.

5. Respecting the tonnage for which the proposed New York-Philadelphia ship canal could compete, we cannot see that the total tonnage between Long Island Sound and Chesapeake Bay (supposing that Professor Haupt includes the tonnage plying in both these waters) has much to do with the case. The question is, what is the annual tonnage of freight moved by water between New York Bay and Delaware Bay, and how much of it could be made to patronize a ship canal at paying rates of toll instead of taking the longer route? It is true that large quantities of coal are shipped by water from Philadelphia, but would not a "steam collier," as the English say, prefer to strike for the open ocean, if bound for Boston or Rhode Island ports, rather than navigate the upper Delaware, the ship canal and the crowded waters of New York Bay, the East River and Long Island Sound?

6. Professor Houpt brings up a point which is worth serious attention, when he speaks of the delays in railway freight traffic due to the time spent in yards. The fact is, and it is a most important one, which is far too often overlooked, that in these days, when freight is moved on the open road at such small cost, the question of relative terminal facilities is of the greatest importance in the case of competition between two transportation routes. It must be admitted that in handling heavy freights from a warehouse on the water front of New York city, or the cities surrounding it, to a warehouse on the Delaware at Philadelphia, or the reverse, an all-water route might have considerable advantage. On the other hand, when we consider the matter of the transfer of freight which has to be transhipped at each end to a freight car to finish the journey, it is not apparent how the water route can hope to compete. Briefly stated, for such short distances the terminal charges form a large proportion of the total cost of transportation. It would not be well, however, to base any hopes of traffic on being able to move freight from terminal to terminal more quickly than the railway. It would be an exceedingly short time after a water route from New York to Philadelphia commenced to take freight from the railways by reason of its quick time when the railway traffic departments would have arrangements completed to deliver goods in Philadelphia within six hours, or less, of their shipment at New York.

7. Because New York and Philadelphia are two great commercial centers, it does not follow that there is a great volume of bulk freights to be exchanged between them. The two cities are, in fact, too similar in their industries to have a great volume of exchanges of the coarser materials of traffic. They are in many lines, perhaps in most lines, competing with each other, rather than doing business with each other.

8. From what we have already said it will be apparent that we cannot approve Professor Haupt's estimate. He computes, however, that $2,400,000 would represent the benefit to traffic by the canal. But he cannot charge all this in tolls. The ship owner must have at least half the profit to induce him to use the canal. Then $1,200,000 would be the interest on an investment of $20,000,000, which would not appear to be an extravagant estimate of the total cost of building 34 miles of canal and obtaining 20 ft. of water in the Delaware above Philadelphia for a distance of 25 miles. In fact, it is extremely doubtful whether capital could be interested in the enterprise without a pretty sure prospect of better profits than 6%.

9. American railways can handle freight far more

*Since the above was written, the figures for the year ending June 30, 1893, have been published (Eng. News, Sept. 7). They show a rate of 0.878 cts. per ton-mile, and an average cost of 0.579 cts. as the average for the whole United States on all classes of freight.

cheaply than railways on the Continent of Europe; and it is not at all certain that it would be economy to multiply water routes to such an extent here as has been done abroad. As for French national prosperity, we believe most economists ascribe it chiefly to the industry and frugality of the French peasants.

Finally, let us see how the scheme would naturally be looked at by the man who is weighing its prospects with a view to investing money in it. Such a man will look most keenly to see where the traffic is coming from to pay sufficient tolls to make the enterprise a profitable one. In the first place, little or no use of such a canal would be made by sailing vessels. It would be preposterous to have a vessel equipped with sails merely for the short run from New York to Perth Amboy, and then tow her all the way up the Raritan Bay, through the canal and down the Delaware River. The traffic on the canal would practically be confined, then, to steamers and barges. As respects the latter class of traffic, it is by no means clear that it would be wise to build so deep a canal as Professor Haupt proposes (20 ft.) to accommodate it, since barges of large capacity would be as well accommodated by a much shallower channel. Practically, then, the promoters of the enterprise must satisfy capitalists that a sufficient number of large size steamers will patronize the canal to make it a more profitable enterprise than a shallower canal would be, which could accommodate only barges and tugs. Whether they can do this remains to be seen.

We would roughly estimate as follows: Assume the cost of carrying bulk freight in steamers of, say, 18 ft. draft at one mill per ton-mile, not including cost of loading and unloading. Assume expense of one mile of canal and river navigation (exclusive of tolls) to equal that of three miles of ocean navigation. Then, if the distance from New York to Philadelphia by the present water route is 200 miles, and by the proposed canal route would be 30 miles, plus 50 miles of canal and narrow river channel navigation, we have the saving to the steamship owner by the use of the canal equivalent to the cost of sailing 80 miles, or at one mill per ton-mile, a total saving of 8 cts. per ton. On the basis of an equal division with the ship owner, this would give the canal 4 cts. per ton as tolls. That there is traffic in sight to promise a profit on the building of the canal at such a rate of toll will hardly be claimed.

To sum up, the two principal obstacles to the success of the scheme seem to be the low cost at which freight can be handled by rail from Philadelphia to New York, and the comparatively small distance which is actually saved to steamers. If some convulsion of nature should extend the state of New Jersey a few hundred miles farther south, the prospects for the proposed canal would be much improved.

As we said at the outset, it is our desire to present the figures on both sides to our readers; and we, therefore, have delayed the publication of the above until proofs could be submitted to Professor Haupt, and an opportunity be given him to reply. We append his rejoinder, as follows:

Sir: The above review having been submitted for discussion before publication, the opportunity is accepted with thanks; for the desire expressed by you to get at the facts is commendable, as the injury resulting from an ill-considered work is often irremediable.

The review is too detailed and space too restricted to admit of a consideration of all the items seriatim, and I can only now state a few of the reasons wherein I think you have not reached the correct conclusions.

1. Objection is made to the relative rates by rail and ocean and the date of the statistics, yet you quote the Report of the Interstate Commerce Commission for June 30, 1892, while I quoted from the Report of the Committee on Commerce to Congress for the same year, for the average rail rate, and from Engineering News itself of June 28, for the minimum rate, viz., "four mills," which I believe is about right. After some research the News has discovered an exceptionally low figure, viz., that of the Beech Creek R. R., of 0.225 ct., as the cost (not rate) of a ton-mile. This, I think, is specializing too far and does not form a safe basis for comparison, as this is an unusually "low grade" road and its traffic is not affected by the canal. On the United R. R.'s of N. J., which parallel the canal, the cost of moving a ton a mile in 1893 was .983 ct., which is above the average quoted by me. Now, as to the basis of our relative rates, no less an authority than Senator William P. Frye state, in presenting his report in 1892, that the lake marine alone has created a means of transportation costing to-day only one-ninth the cost of the same service by rail, and its ton-mileage was 27½% of that of all the railways of the United States.

Now, since the ocean rate is, in general, less than that on the lakes, I think that there is no reason to question the ratio of 1 to 8 as a fair presentation of the cost of movements by rail and by ocean, or of 1 to 4 for rail and ship canal, especially as contrasted with the cost by rail on the parallel line, as stated in my first thesis. These rates are pertinent, in my opinion, because it is not intended to build a canal simply to connect New York and Philadelphia, but one of far greater scope, reaching, say, from Boston or Portland to Norfolk, or even farther south, and when the Great Lakes and Hudson are connected by deeper channels, its influence will extend to Chicago, Superior, and even to points on the Mississippi and Missouri rivers, just as the Erie canal to-day regulates rail rates on the Gulf of Mexico. (Vide Albert Fink's reports.)

2. As to this thesis, there was no such assumption as you have placed upon it. The last part of the clause (not quoted) shows that the rate was the same; else, of course, the question of prorating must enter the problem.

3. The time factor is dismissed with the statement "that if important, the distance could be made in very much less time than 24 hours." The average speed is 11 miles per hour, the distance, say, 170 miles via the Capes, while, via canal, it would be 55 by river and bay or 5 hours and 34 by canal, requiring 7 hours, including the lockage, or 12 hours in all. Tugs of 7 ft. draft now often steam along the canal at the rate of seven miles an hour.

4. As to the astonishment expressed that 29% of the vessels "risked" are lost, I fear you have misconstrued the language. It is not 29% of the value from merchant marine that is lost, but of the property jeopardized and in danger of being lost. The property "risked" was valued at $3,788,140 by the last report of the Life Saving Service, while that lost was $1,146,395, or 29%, a loss more than sufficient to pay the interest on the cost of the canal. The editor appears to think the dangers on an interior waterway greater than those outside, whereas the writer is informed that the insurance rate inside is about one-half that by the outer line. Hence the danger would be about one-half.

5. As to the tonnage, I cannot agree that it is a question of how much of that now going by water between Delaware and New York bays would use the new route, nor even of the present total tonnage by rail and water. Projectors are not in the habit of estimating revenues upon a fraction of the existing traffic, for the increased facilities promote traffic. It should not be forgotten that under more favorable conditions as to rates, the former business of this limited canal of only 7 ft. draft exceeded 3,000,000 tons in 1866 and produced a revenue (net) of about $933,000. At the rate the traffic was growing at that time it would now exceed 10,000,000 tons, had the facilities been increased in the same ratio. It is no exaggeration, therefore, to figure on even 20% of our coastwise commerce as patronizing the canal in the near future. This would exceed 10,000,000 tons per annum in a short time. The managers of the largest coal-shipping concerns in Philadelphia believe their colliers would prefer the canal route, if there were a draft of only 16 ft., and this would put from 3,000,000 to 4,000,000 tons of fuel into the New York and Eastern markets at probably 50 cts. per ton less than now. This is merely one of the economies of the line against which it seems futile to theorize. It would increase the consumption of coal and cheapen manufactures.

6. The reply which you make to this proposition assumes that the railways are able to make much better terminal arrangements than they offer at present and to deliver goods in much less time. If this be possible, then they are remiss in their duty to the public as common carriers, and if the canal would have the effect stated, it would be worth all it cost, even if it did not carry a ton of freight, for the transfer, lighterage and terminal charges of New York are a heavy tax, which should be removed if practicable.

In short, the burden of every argument urged by the editor above is to the effect, either that the premises are incorrect, or that there will be no traffic sufficient to pay, and the great economic effects upon transportation by large and deep draft canals the world over is overlooked. The argument is summed up by the statement that the boats might afford to pay 4 cts. for tolls. It will be difficult to understand how it is that the present limited traffic over a route 11 miles longer and on the shallow canal now in use can collect over 60 cts. tolls, and why an enlarged canal, with far greater traffic and relatively lower fixed charges should not be able to conduct its business at a less cost and make money. I believe, therefore, that this canal will prove to be an unmixed blessing to all parties and interests concerned.

Very respectfully yours, Lewis M. Haupt.

Philadelphia, Sept. 8, 1894.

We take space for only a few brief comments on Professor Haupt's letter. With reference to the relative rates by rail and by canal, we would urge that average rates on all classes of freight be not confused with the much lower rates on bulk freights, in the carriage of which alone could a canal hope to be an important competitor; neither should the present charges of a road operating with little or no competition be taken as a basis for fixing the probable rates and volume of traffic of a line to be built to parallel it. It is this unsafe method of computing future profits which has led capitalists to sink money in numberless unsuccessful enterprises; witness the West Shore and Nickel Plate bubble, for example. That the relative cost per ton-mile of rail freights and of freights on a thousand-mile ocean or lake voyage has little to do with the merits of the scheme before us, appears too obvious to question, since canal rates must be far higher than rates on the open ocean and rates for short voyages are of necessity far more than for long ones.

For that matter, according to Professor Haupt's own statement, 90 cts. per ton is the water rate from New York to Philadelphia, which, assuming the distance at 200 miles (not 170, as he puts it, probably by a slip of the pen), is 0.37 ct. per ton-mile. From Professor Haupt's figure of .983 ct. as the average receipts on all classes of freight on the united railroads of New Jersey, it is evident that the Pennsylvania R. R. can make a bulk freight rate per ton-mile less than double the water rate, and still reap a handsome profit.

We are glad to have the matter of the risk to our coastwise traffic straightened out. Professor Haupt's statement that 29% of the property risked was lost means on its face that 29% was the actual rate of annual losses; otherwise the figure 29% has no pertinence whatever in discussing the merits of the enterprise before us. What the report of the Life-Saving Service really says is that of the vessels which went ashore, or grounded, enough were floated off, or enough cargo was saved, to make the total loss only 29% of the total value of such vessels and their lading. Taking Professor Haupt's own figure of 60,000,000 tons as the total coastwise traffic in the area where these losses occurred, it appears that the ratio of annual loss is only about one dollar lost for every 55 tons of cargo carried. Evidently it will not be worth while for ship owners to pay much toll on account of increased safety, even on Professor Haupt's supposition that the dangers are decreased one-half on the canal.

Professor Haupt speaks truly when he says that "projectors are not in the habit of estimating revenues upon a fraction of the existing traffic." It would be well if they were content to claim a fraction only, and not the whole, for over and over again has experience shown how difficult it is to change existing channels of trade, and that any new route must be content with a fraction, and usually a small fraction, of the business for years to come. There is no more common error in the starting of new enterprises than to neglect to carefully measure the market for the thing produced. Very likely traffic on the proposed ship canal would have a steady growth from a small beginning; but stockholders do not like to wait too long for a return on their investment.

Concerning the Delaware & Raritan Canal, the $933,000 net earned in 1886 was in inflated currency and was really equivalent to some $450,000 or so in gold. In 1893 its gross earnings were $317,141, and its operating expenses were $331,470. It may be said that under the Pennsylvania Railroad's control, traffic is diverted from it; but let us not forget that the railway transports goods far more cheaply, promptly and efficiently now than in 1866.

Professor Haupt thinks as a means of improving the terminal facilities and the rapidity of handling shipments, the canal would be worth all it cost, even if it did not carry a ton of freight. Granting this to be true, it would be pretty rough on the stockholders in the canal company. If present facilities are not what they should be, there ought to be some cheaper spur to bring about their improvement than a $12,000,000 canal.

Concerning the present 60-ct. rate of toll on the

Delaware & Raritan Canal, we understand that the present canal practically counts for nothing in the through traffic between Philadelphia and New York; so its rates of toll do not affect our contention that to induce vessels to choose the canal in preference to the free pathway on the open ocean, rates of toll must be made very low.

Finally, our correspondent hints that we fail to appreciate at their full value the merit of ship canal enterprises generally. We do not think our discussion can properly leave such an impression on the mind of the careful reader. A vast deal of nonsense has been printed on the subject of ship canals during the past few years, and it is quite time that the plain fact was set forth that a ship canal is an enormously costly work, and can be made profitable as a commercial enterprise only at a few favored locations on the globe, where a large traffic will reap great benefits from its use. Of course such canals as Suez and Nicaragua are among the world's greatest and most beneficent enterprises, for they save vessels the circumnavigation of a continent and shorten voyages by thousands of miles. Of course such a canal as that at the Sault is of enormous benefit, for it is the closing link in a water transportation route a thousand miles in length. But when we reach such enterprises as the Corinth Canal and the Manchester Canal, just completed, we find that the financial success of these enterprises is extremely doubtful. It is a pity that this is the case, for the investing public, with little discrimination, is likely to turn a deaf ear to really meritorious ship canal schemes for years to come because of these enterprises and because of the fiasco at Panama.

Every engineer knows it will not pay to build a ship canal merely to parallel a railway line, nor to build one which merely parallels a route for open water navigation on lake or ocean. Between this extreme and such short cuts for the world's commerce as Suez there is a vast difference, and only a careful investigation of each enterprise separately will determine whether it is below or above the line where the benefit to traffic just equals the interest on the cost of construction.

LETTERS TO THE EDITOR.

THE RESILIENCE OF CAST IRON.

Sir: I have read with much interest Professor Merriman's able address on "The Resistance of Materials under Impact." Desiring to obtain further information concerning the properties of cast iron, I quote below several statements there made, omitting such portions as do not refer to this material.

It is a principle of elastic resilience that a force suddenly applied to a rod or beam produces double the elongation and double the stress caused by the same force when gradually applied, but this is not true when the elastic limit is exceeded, and it should not be expected to be true when materials are tested to destruction. Hodgkinson found it closely verified for cast iron, but this is because the ratio between stress and elongation of that material is not subject to wide variation, while an elastic limit scarcely exists. . . . So with the deflections of beams under ultimate resilience, cast iron agrees fairly with the elastic law. . . . So with the elastic law of the proportionality of resilience to the volume of the bar, cast iron is found to fairly agree under conditions of rupture. . . . The old paradox in the theory of beams is of a similar nature.

I desire to ask whether it may not also be consistently stated that when this material is subjected to transverse stress from static load, all conditions relating to the deformation of the material are approximately and very closely the same at rupture as within the limit of elasticity. Such a statement would appear to be in harmony with the statements quoted above.

Benj. F. La Rue.

Scranton, Pa., Aug. 28, 1894.

(We have referred the above letter to Professor Merriman, who replies that the statement is probably correct, roughly and approximately, but not "very closely." Many experiments on cast and wrought iron beams show that the deflections of the former, when the elastic limit is much exceeded, are more nearly in proportion to the loads than those of the latter. Of course the elastic limit is very poorly defined in cast iron, but there is no flow of the metal under severe stress as in wrought iron. If such a thing as ultimate deflection under static transverse stress is possible for wrought iron the elastic formula will probably give scarcely one hundredth of its value, whereas for cast iron it often gives more than one-half the observed deflection.—Ed.)

SPECIFICATIONS FOR PUMPING ENGINES.

Sir: We note with interest the editorial note in your issue of Aug. 9 on clauses in specifications regarding non-fulfillment of guarantee for duty of pumping engines. It is surprising when one looks over the great number of results of duty trials that have been published to find that a considerable number of engines thus tested failed to come up to the guaranteed duty. We have long felt that in drawing up specifications for pumping engines a clause should be introduced providing for a reduction in price in cases of failure to show the duty up to the guarantee. You will notice in the specifications for pumping engines for the new water-works at Steubenville,, O., that we not only provide for such a contingency, but also specify that the duty shall not fall below 5,000,000 ft.-lbs. less than the guaranteed duty without making the engines liable to rejection by the engineers. This is to prevent too great a departure on the part of the contractor from his guarantee.

While our plan of determining the rebate is controlled by the capitalized value of the additional amount of the coal used, we have not specified the exact rebate, preferring to leave this for agreement between the parties concerned before the signing of the contract.

The specifications which we enclose were made in May, and so far as we can learn are the first specifications in which this point is covered.

Yours truly, Wilkins & Davison.

Pittsburg, Pa., Aug. 18, 1894.

(The clause in the specifications relating to tests is given below.—Ed.)

After the pumps have been put in successful operation, and upon written notice to the engineer by the contractor to that effect, the pumps will be operated for 90 days as a test of their capacity under these specifications, and their durability under the working capacity. At the end of 90 days' satisfactory operation of the plant, duty tests shall be made by and under the direction of the engineer, to test the duty proposed by the contractor. The tests shall be made in accordance with the standard method of conducting duty trials of pumping engines as recommended by the American Society of Mechanical Engineers. In case of the failure of the engines to fulfill such guaranteed duty while running under the conditions named in all specifications referring to said engines, the contractor shall pay the city of Steubenville an amount to be agreed upon before signing the contract for each 1,000,000 ft.-lbs. that the determined duty is less than the guaranteed duty, as liquidating damages sustained by the city of Steubenville for such failure to fulfill the guarantee.

Should the engines fail to perform a duty within 5,000,000 ft.-lbs. of the guaranteed duty, or should they fail to show the capacity called for under the conditions of the specifications, the engines will be subject to rejection by the engineer. Such rejection, however, will not release the engines to the custody of the contractor, until engines of proper duty and capacity shall replace the ones rejected. They shall be operated to furnish water to the city of Steubenville as circumstances may require, and without rental to the contractor. The city shall not be responsible to any damage to the pumps while under such use, that may be the result of defective material or workmanship in said engines as constructed by the contractor.

Each of the pumping engines shall be tested, each test to cover a period of at least ten hours. In these tests the heat charged to the engines shall be the total heat consumed in all manners and devices in which the heat is used to perform or aid in performing the duty mentioned. The expense of the duty tests shall be borne by the contractor.

NOTES AND QUERIES.

Mr. J. L. Campbell writes that in his letter on transition curves, published Aug. 23, 1894, he said that the spiral angle S is equal, in the figure, to H' O' P. It should read S = L O' P.

CHANGING THE GAGE OF A SOUTHERN MINERAL RAILWAY.

By Hunter McDonald, M. Am. Soc. C. E., Chief Engineer, N., C. & St. L. Ry.

The development of the immense deposits of iron ore and heavily timbered lands of Hickman, Wayne and Lewis counties, in Tennessee, was for many years the object of the untiring efforts of Mr. L. S. Goodrich, a noted ironmaster in the early days of ironmaking in Tennessee. He sought to build a narrow gage from Dickson, Tenn., on the Northwestern Division of the Nashville, Chattanooga & St. Louis Ry. directly southward. He secured the services of Maj. E. F. Falconet, an engineer who had been prominently connected with many large enterprises in the South, and a company was formed, most of the stock subscriptions being in the shape of timber, labor and use of teams. A contract was made with the Nashville, Chattanooga & St. Louis Ry. to furnish the iron to lay the first 20 miles of the road and operate the same whenever it was graded.

The country was very rough, being a tableland, cut in all directions by deep valleys with steep sides, requiring that the location adhere to the ridges as far as possible and seek valleys for descent and ascent whenever it became necessary to leave the ridges. The region was almost a wilderness, it being impossible to raise anything on the land except in the bottoms of the deep narrow valleys.

The location was begun about 1877, the principal object of the engineer appearing to have been to grade his 20 miles with the limited means at his disposal, with little regard to the economical operation of the road afterwards. After many months of labor without remuneration and at the risk of their private means, the road was finally completed for 20 miles, and the track was laid with 30-lb. iron rails. The sharpest curve was 42° and the maximum grade 4%. These curves were seldom resorted to, but 32° curves were common, and there was hardly a cut over 5 ft. deep on the whole 20 miles. It was said that the road was graded at a cost of $250 per mile. A loop at the end of the 20 miles served to turn the trains. A charcoal furnace was erected at Warner by Mr. J. C. Warner, who has been prominently connected with the development of the iron interests of the South for many years past.

When the Nashville, Chattanooga & St. Louis Ry. Co. began the operation of the road it was at once apparent that it would never pay. However, many corrections in alinement and grades were made from time to time and the operation was not only continued, but the road extended, until it is now 62 miles long, and has five furnaces along its lines. Major Falconet continued as locating engineer on all extensions until his death, a few years since, and Mr. Goodrich lived to see the first 33 miles of the road completed, and two furnaces in operation. The maximum curve on that part of the road beyond the first 20 miles is 22° and the maximum grade 3%. Horseshoes are of frequent occurrence even with these high maxima. Much of the grading of the road in later years was for standard gage, and preparations for changing the gage have been going on for the past five or six years, the grading being gradually widened and the trestles strengthened. Many of the truss bridges on the line were old ones, originally built on the main line, but which gave place to heavier ones as the traffic increased. None of these bridges have as yet been strengthened, and several of those originally built for 30-ton engines are still in use.

During the hard times of 1893-94 the furnaces all shut down and the business of the road was almost nothing. Only one train a day passed over it, carrying little else but mail. About this time, however, the newly-discovered phosphate rock began to attract attention, and believing that this was destined to give the little road a great deal of business, it was decided to complete the change of gage while the traffic was light. The putting in of the ties was begun in April last. All of the 30-lb. rails had in the mean time been replaced by 56-lb. iron rails on the sharpest curves and 40-lb. iron rails on the tangents and light curves, while 40-lb. iron rails had also been laid on that part of the road built by the N., C. & St. L. Ry. It was decided to spread these rails out, to limit the load of cars to 40,000 lbs. and to widen the gage of those locomotives which would admit of it. Standard gage ties replaced every third narrow gage tie on straight

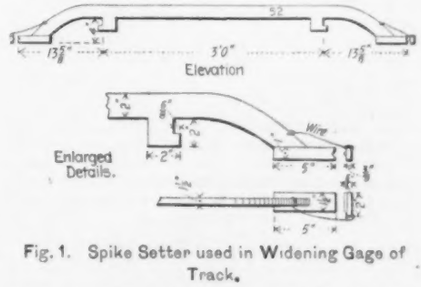

Fig. 1. Spike Setter used in Widening Gage of Track.

lines, every other tie on curves of 6° and under, and all ties on curves sharper than 6°.

Prior to the day of change, spikes were set to which the rails were to be thrown, by means of the "setters" shown in Fig. 1, and the ties were

adzed to receive the rails by the "spotters," shown in Fig. 2.

The spike setters were of four sizes, the distance from lug to outer edge being respectively 13, 13⅛,

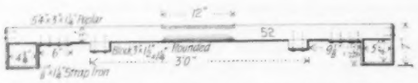

Fig. 2. Tie Spotter used in Widening Gage of Track.

13¼ and 13⅜ ins. They were made to fit four separate sections of rails, namely: 38-lb. steel, 40-lb. iron, 40-lb. steel and 52-lb. rails. The spotters, Fig. 2, used in adzing the ties before widening the gage were of two sizes, one for 38 and 40-lb. rails and the other for 52 and 56-lb. rails. The latter is the one shown, and the only difference in the former was that the bar was 5 ft. 2¾ ins. long, the end loops 3¾ ins. wide and 3¼ ins. deep and the depth over loops 6¼ ins.

All preparations having been completed, it was decided to make the change of the rails with the force of men then at work on the line, stopping the daily train as long as necessary, thus avoiding the expense of importing more labor. Accordingly on June 27 the 180 men, exclusive of foremen, were divided into gangs of 30 men each and the road was divided into six divisions of about eleven miles each, including sidings, the length of the respective divisions depending on the amount of curvature to be encountered.

Each gang was organized as follows: 8 men drawing spikes, 4 men throwing rails, 12 men spiking, 1 man distributing spikes, 2 men pushing handcars, 1 man carrying water, 1 man driving down stubs, 1 man extra.

The tools for each gang were as follows: Nine claw bars, 4 lining bars, 3 gages, 13 spike mauls, 1 water barrel, 2 water buckets, 1 broad-gage dump car, 1 broad-gage lever car, 1 narrow-gage dump car, 1 punch, 4 cleavers, 1 wrench, 2 18 or 20-ft. rails and one pair of splices and bolts to be placed about the middle of every curve over 6°, in case rails were to be cut.

Two foremen were placed with each gang, one having general charge and the other one having direct charge of the spiking. This organization could not at all times be strictly adhered to, as the trouble on account of curves was variable. Each gang was ordered to begin at a given point on its division and continue work until completed. Some gangs finished in two days and one required three days. Work was begun on June 27 and completed on June 30. Regular schedules were not resumed until July 1. The actual cost for such grading as was absolutely necessary, finishing and putting in ties as described above and making the change, was $580 per mile.

The 30-ton consolidation Baldwin engines, which were widened in the company's shops, are running around the 30° curves with as little trouble as when they were narrow gage. Few of the cars were susceptible of change and most of them will go to the scrap pile. Although the furnaces are still shut down, the movement of the phosphate rock has given the little road all it can do until it is prepared for the heavier engines.

A NEW SYSTEM FOR HANDLING BULK FREIGHTS.

We illustrate herewith a new system of transferring bulk freights from cars to steamers which is in successful operation at Ashtabula, Ohio, and for which many points of superiority are claimed. Everybody is familiar with the common dumping wagons used by retail coal dealers, in which the front end of the wagon is raised till the coal slides out of the rear end. The inventor of this system simply does the same thing to an ordinary gondola car, taking it up on a huge tilting platform and inclining it until its contents slide out at one end.

While this system is applicable, generally speaking, to all classes of bulk freights, its chief advantage is in the handling of coal, where it is found to save breakage over any other system in use. As many of our readers know, all through the season of open navigation a great fleet of freight carriers plies back and forth on the Great Lakes, and a large part of its business consists in the carriage of iron ore from the Michigan and Minnesota mines to the ports of Northern Ohio, returning with coal from the mines of Pennsylvania, Ohio and West Virginia. For several years past lake shipments of coal from the Pittsburg, Hocking Valley and West Virginia districts have averaged about 3,000,000 tons each season. This coal is of a high grade, suitable for fuel and steam purposes and for the manufacture of gas and coke, and shippers have tried various methods of loading it into vessels without damage from breakage.

As far back as 20 years ago attempts were made to handle coal on the lakes by means of chutes, and on the Cleveland docks of what is now the Big Four Railway as much as $65,000 was expended on a single plant that had to be abandoned soon afterward, on account of damage to the coal in handling it. With the advent of big steel steamers and wooden boats of largely increased capacity, rotary derricks, handling first buckets of ordinary size and later on buckets of five tons capacity, were introduced into the trade, but even with these the largest vessels were delayed two to four days in loading, and with eight or ten men shovelling into buckets from a car 3 ft. deep, and not taking probably more than 20 lbs. to a shovelful there was still the disadvantage of separation in the coal and consequent breakage. The effort, therefore, has been to secure despatch for vessels approaching that obtained in the ore trade, where ships of 3,000 to 3,500 tons are loaded in a few hours, and at the same time avoid loss in the commercial value of the coal by overcoming as far as possible the breakage referred to.

The machine illustrated herewith has been designed to meet these requirements. It was built by the McMyler Manufacturing Co. for Pickands, Mather & Co., the Cleveland representatives of the Minnesota Iron Co. and the largest forwarding merchants of coal and iron ore at Cleveland. Patents on the machine are controlled by the McMyler Car Dumping Machine Co., Western Reserve Building, Cleveland, Ohio. Our illustrations are taken from photographs of this first machine at work at Ashtabula, where it was operated a sufficient time to prove its practicability and to encourage its owners to believe that it is destined to revolutionize the business of handling coal on the lakes.

Describing the machine and its operation more fully, it consists of a tilting plate girder supported on a turntable, the whole carried on four heavy car trucks, running on two lines of rails spaced about 20 ft. apart between track centers. These tracks are laid along the edge of the wharf, and the vessel to be loaded is moored alongside, so that the short arm of the tilting bridge is over the vessel's hatches.

Opposite the dock, and perpendicular to it, several lines of railway tracks are laid. Fig. 2 shows the arrangement at Ashtabula, where six double lines of tracks are laid, spaced about the same as the vessel's hatches. In operation, the vessel being placed so that the hatches are opposite the tracks,

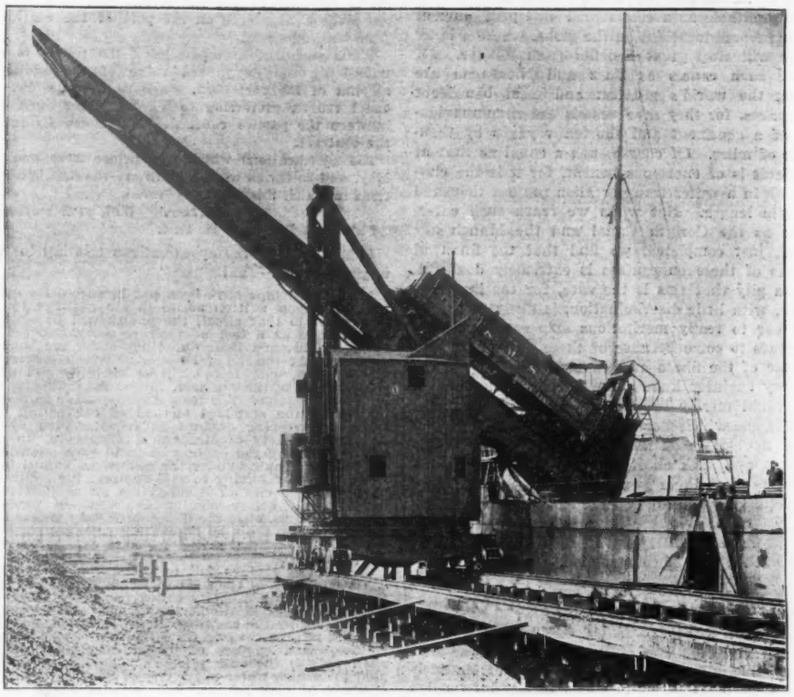

Fig. 1. THE McMYLER CAR DUMPING MACHINE EMPTYING A CARLOAD OF COAL INTO A STEAMER'S HOLD.

or nearly so, the machine is moved to the hatch into which it is desired to load and a 1¼-in. steel cable is hooked into the drawhead of the car and the car pulled up to the upper or shorter end of the bridge, which is so constructed as to form a bumper, against which the end of the car rests when tilted. The bridge is then tilted, and at the same time the end board is automatically withdrawn and the coal flows out through a discharging chute, and is concentrated in a telescopic trough or spout, which may be lowered to within a few feet of the bottom of the vessel, when the work of loading begins at any of the several hatches, or only to the surface of the coal itself after the bottom of the vessel is covered. In double-decked vessels this chute may be lowered to the bottom deck combings. After the load is discharged the bridge is tilted back, the cable is detached and the car is allowed to run down and off the incline onto the track provided for "empties," a loaded car is again taken up, and so the operation continues, the machine moving from one set of tracks to another and from one hatch to another as may be required by supplies of loaded cars, or to permit trimming the cargo. Through this latter operation a great saving in time is gained, as occasion for shifting a vessel while the work of loading goes on is very rare. Not only can the machine be moved laterally in either direction with a car on the bridge or platform, but it may be swung at the same time to avoid spars or any other obstructions on a vessel. One of the best features of the machine is its adaptability to the kind of railway car in general use in the bituminous coal trade. The only change required is that of fitting sliding end boards in the

cars, which can be done at a trfling cost. Immediately upon preparations being made for the erection of this first machine at Ashtabula, the management of the Lake Shore and the Pittsburg & Lake Erie railways, two coal lines running into that port, caused 1,000 cars to be fitted with sliding end boards, and work has been started on 1,000 more of the same kind.

The capacity of the surface track plant, shown in Fig. 2, and from which cars are moved onto the platform of the machine by a locomotive constantly in attendance, is 140 cars, or about 3,300 tons. Of course the number of sets of surface tracks for loaded and unloaded cars depends entirely upon the number of cars it is desired the plant shall handle, and as the entire transferring apparatus is arranged to move along the dock line, it can, therefore, be made to accommodate any desired number of tracks and length of dock.

The bridge is tilted by a hydraulic ram 18¾ ins. in diameter, mounted on trunnions, and it rights itself by gravity, the ram forming a safe and efficient brake. From a hydraulic accumulator, having at one end a hydraulic piston and at the other a steam piston of ten times the area, pressure water

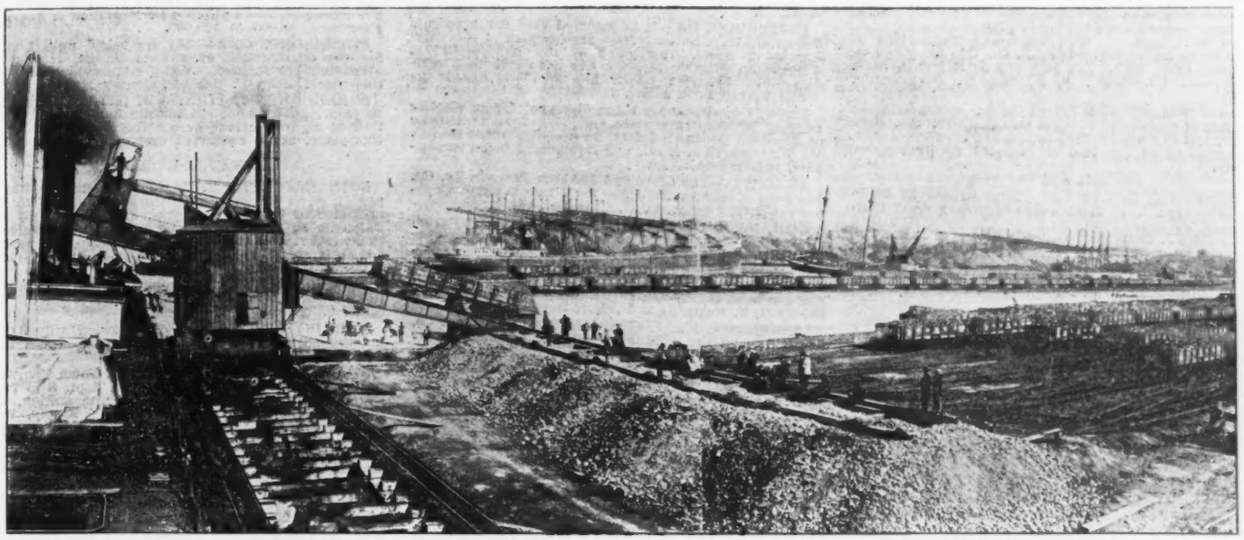

FIG. 2 THE McMYLER CAR DUMPING MACHINE AT ASHTABULA, O. VIEW SHOWING TRACKS DELIVERING CARS TO MACHINE.

is taken to operate the friction clutches, by means of which one operator controls the entire machine. Only four men in all are required, the other three being a fireman, a man on the bridge and a man to attach the cable to the drawhead of the car. A pair of steam pumping engines furnish the hydraulic power to operate the machine.

The rapidity of work with the machine is surprising. Several records as high as 15 cars per hour unloaded, or a total of 345 tons, have been made with the apparatus, and steamers of 2,000 to 3,100 tons have been loaded in 8 to 12 hours. On Aug. 8, 3,259 tons of coal were put on board the "Yuma" in 12 hours. From June 27 to Aug. 22 the machine loaded 29 vessels, handling a total of 59,794 tons, the actual total time consumed being 300 hours and 40 minutes, an average of 198 tons per hour.

THE CESSION OF ARID LANDS TO THE STATES.

The efforts of the Western states to secure the cession of arid lands from the national to the state and territorial governments have been partially successful. An amendment to the Sundry Civil Bill, which recently became a law, provides for the cession of 1,000,000 acres of arid lands to each of the states in question, provided the latter will take certain measures to reclaim the land by irrigation. The provisions of the law are as follows:

That to encourage the reclamation of arid lands, and the cultivation and sale thereof in small tracts to actual settlers, there is hereby reserved, for the purposes and upon the conditions provided in this section, in each of the states to which the desert-land law of the United States is applicable, to Nebraska and Kansas, and to each of the states that may be formed out of the territories of Arizona, New Mexico, Oklahoma and Utah, 1,000,000 acres of the surveyed public arid lands in said states, respectively, to be selected by each of said states within the ten years after the passage of this act, and such reservation to take effect from the date of such selection and approval, and be thereafter withheld from other disposal, except as hereinafter provided:

Provided, That any lands so reserved, which shall not be reclaimed within five years from the date of their selection and approval, as aforesaid, or as to which the state has not expended or caused to be expended the sum of $3 per acre in works intended for the reclamation of such lands, as now required by the United States desert-land law from claimants thereunder, shall be released from such reservation and become subject to disposal as other public lands of the United States, after proclamation by the President so declaring. That any state accepting the conditions of this section is hereby authorized to make all necessary regulations governing the manner or extent of the reclamation, and to make all contracts to cause said lands to be so reclaimed and settled and cultivated by actual settlers in accordance with such regulations; and as rapidly as the state may furnish competent proof that any of said lands are reclaimed and occupied by actual settlers, in accordance with its said regulations, patents shall issue to the state or its assigns for said lands so reclaimed and settled.

Provided, That said states shall not sell or dispose of more than 160 acres of said lands to any one person, and the net proceeds derived by each state from the sale of said lands shall be held and expended as a separate fund to aid the work of reclaiming the lands so reserved by this section, and the surplus, if any, shall be devoted by the state to reclaiming other arid lands in said state. That all lands, exclusive of timber lands and mineral lands, which will not, without irrigation, produce some agricultural crop, shall be deemed arid lands within the meaning of this section, which fact shall be ascertained by affidavit of two or more credible witnesses, filed in the land office of the district in which such land may be situated at the time of the selection thereof, as herein provided:

Provided, That this section shall not be construed to authorize the leasing of the lands selected or the disposal or use of them by the states, respectively, in any way whatever, except to secure their reclamation, cultivation and settlement; and the Commissioner of the General Land Office, subject to the approval of the Secretary of the Interior, shall make all rules and regulations necessary to carry out the provisions of this section; and to enable the Secretary of the Interior to examine any of the lands that may be selected under the provisions of this section there is hereby appropriated out of any moneys in the treasury not otherwise appropriated, $1,000.

An interlocking switch and signal plant has been put in at Laughlin Junction, on the Baltimore & Ohio R. R., by the Union Switch & Signal Co. In the tower from which the switches are operated there are 22 levers, operating 20 switches and 20 signals and one set of movable crossing frogs. The switches are 15 regular and 5 derailing switches, and the 20 signals are on three low or dwarf posts and nine high signal posts. The switch connections are all made with 1-in. gas pipe, while the signal connections are made with wire, of about 3-16 in. diameter. The most distant signal post is over 1,200 ft. from the tower. There are three of these distant signal posts, one governing each point of the triangle. The derailing switches are located 50 ft. inside of these distant signals. The connections of these derailing switches and the semaphores are so arranged that they move together, that is, the signal and the switch are moved by the same pull of the lever, and cannot be moved separately.

An electric locomotive, designed for speeds up to 30 miles per hour, has been built by the General Electric Co. Its general form resembles the one shown in our issue of July 13, 1893, but it has longer ends and is carried upon two four-wheel trucks, with 40-in. wheels and 6-ft. truck wheelbase. It is 24 ft. long, 11 ft 2 ins. high and 8 ft. 4 ins. wide, weighing 40 tons. At each end is a pilot, coupler head and air-brake hose, an air compressor supplying air for the brakes and whistle. There are eight elliptical springs, which rest on the axleboxes and carry the frame of the machine.

Mt. St. Elias, according to the latest report from the joint boundary survey authorized by the United States and England, is not in United States territory. Nor is it the highest mountain on the continent, for two or three others have been found, all further inland and on English soil, overtopping it. This survey fixes the height of Mt. St. Elias at 18,023 ft., while Mt. Logan is 19,534 ft. high, and two other nameless peaks a little higher than Mt. St. Elias, but their exact height is not yet determined. This boundary survey, now practically completed, fixes the ownership of the least valuable portions of Alaska, and definitely locates the 141st meridian part of the eastern boundary of this Russian purchase. The hope of the English party was that this line might cut the head of one of the many deep inlets running into the coast and give them access from the Pacific to their own territory. This hope has not been realized, it is said; at least so far as the surveys extended.

In laying the 60-ft. 85-lb. rails on the Norfolk & Western R. R., a gang of about 32 men was found to be sufficient to lay it economically and as rapidly as desired. The gang was distributed about as follows: Eight or nine men pulling spikes and throwing rails out, 16 men picking up and laying new rails in place, 3 or 4 men putting in temporary angle bars, and 4 or 6 men spiking up joints, centers and quarters. The Churchill bridge joints are used. The foreman or some reliable man put in the spacing shims. The expansion space given for 60-ft. rails was according to the following table:

Temp. of rails.	Space bet. rail ends.	Temp. of rails.	Space bet. rail ends.
0°	7/8 in	75°	1/4 in.
25	3/4 "	100	1/8 "
50	5/8 "	125 or above	Laid close

The matter of spacing was considered extremely important and thermometers were kept right in the field all the time so as to get the rail spaced according to temperature at the time the rail was laid up to place. This spacing has been found about right and sufficient. When the thermometer registered temperatures between those given in the table, preference was always given to the spacing required for the next

lowest in the table. The shims were made of iron ⅛ in. wide and in the form of the letter L. The temporary joints used consisted of an ordinary 67-lb. rail angle bar and a small splice bar about 8 ins. long with two holes in it. The splice was put on the inside of the rail and the angle bar on the outside. The splice bar was used for the reason that with its use it was not necessary to draw any of the inside spikes. In laying this rail it was found that very good gage was secured by pulling the outside spikes and allowing the inside ones to remain, and laying the new rails snug up against the inside spikes. The temporary joints were put on and the bolts screwed up tight, so as to hold the proper space between ends of rails as much as possible, until the permanent joints were put on.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

ALTOONA & PHILLIPSBURG CONNECTING.—This railway has been completed from Phillipsburg to Ramey, Pa., and opened for business as far as Houtzdale. The new road will connect with the Beech Creek road and form an important feeder for both that road and the Philadelphia & Reading. Pres., S. P. Langdon, Philadelphia.

BINGHAMTON & STATE LINE.—It is stated that the construction of this railway is being rapidly pushed by Erastus Ross, the contractor. There are no bridges to be built, and the most important trestle will be three miles from Binghamton, N. Y., this being 200 ft. long and 45 ft. high. The line will be laid with 70-lb. steel rails. Ch. Engr., A. K. Harvey, Binghamton, N. Y.

PATH VALLEY.—McGovern Bros., contractors for the tunnel southwest of New Germantown, Pa., have failed, and the work on the tunnel has been suspended. The grading of the line is reported as progressing slowly.

Projects and Surveys.

CHESTER & DELAWARE.—Incorporated in Pennsylvania, Sept. 5, to build a steam railway from Philadelphia to near Paoli, Pa.; capital stock, $150,000; Pres., John J. Patterson, Lancaster, Pa.

WADDINGTON, CANTON & SOUTHERN.—The state board of railroad commissioners of New York has given this company permission to construct a steam railway from Canton to Waddington, N. Y., a distance of about 26 miles.

WATERVILLE.—It is stated that the construction will be commenced this month of a railway from Waterville, Me., to Week's Mills, 14 miles, to connect with the Wiscasset & Quebec road, now being built. It is intended to have both roads completed this fall. W. T. Haines, I. C. Libby, J. F. Arnold, C. E. Gray and others of Waterville, Me., are interested.

Southern—Existing Roads.

ATLANTIC SHORT LINE.—This railway was completed from Bruton, Ga., east 11½ miles in 1891, and the line graded about 26 miles further. The line is projected from Macon to Savannah, 180 miles, and the right of way secured. It is now stated that the construction will probably be resumed at an early date. Pres., J. R. Young, Savannah, Ga.

ATLANTIC, SUWANEE RIVER & GULF.—Work is in progress on the extension, 35 miles long, from La Crosse, Fla., southwest to the Suwanee River, and it is expected to complete it to Osceola, about half way between La Crosse and the river, by Jan. 1. About 20 miles are now in operation from Starke to La Crosse.

CHARLESTON, CLENDENIN & SUTTON.—It is stated that the right of way will soon be secured for extending this railway from Clendenin to Sutton, W. Va. Gen. Supt., C. K. McDermott, Charleston, W. Va.

EAST & WEST.—It is reported that this railway will soon be completed from Pell City to Birmingham, Ala., 20 miles. Pres., Eugene Kelly, New York; Gen. Man., Chas. T. Ball, Cartersville, Ga.

Projects and Surveys.

OHIO & KENTUCKY.—Bids are asked for the construction of this railway, according to reports. The incorporation of the company to build a railway from Morehead to Walnut Grove, Ky., 36 miles, was noted last month. Pres., N. DeL. Walbridge, 1 Broadway, New York.

OPELIKA & AUBURN.—It is stated that rails for four miles of the proposed railway from Opelika to Auburn, 7 miles, have been delivered and that the road will be built as soon as possible. Pres., M. E. Gray, Columbus, Ga., formerly Supt. Georgia Midland & Gulf.

Southwest—Existing Roads.

ARKANSAS SOUTHERN.—This railway is projected from El Dorado, Ark., to Alexandria, La., 125 miles, of which about 7 miles had been completed May 1. The road is being extended to the Louisiana state line, 16 miles from El Dorado. Pres., C. E. Neeley, Arkadelphia, Ark.

CHOCTAW COAL & RY.—This railway, which has been in the hands of receivers for the past four years, was sold at auction at South McAlester, Ind. T., Sept. 8, for $3,500,000. George H. Earl and associates were the purchasers. The company will be reorganized under the name of the Choctaw, Oklahoma & Gulf, and the extension between South McAlester and Oklahoma City will be completed at an early date. Ch. Engr., J. F. Hinckley, South McAlester, Ind. T.

Rocky Mt. and Pacific—Existing Roads.

BUTTE, ANACONDA & PACIFIC.—It is reported that final surveys are being made for the proposed extension from Anaconda to Phillipsburg, Mont.

REDONDO.—This company is reported as contemplating building a branch from Gardena, Cal., south to San Pedro, 8½ miles, or from Redondo north up the coast to Santa Monica, 12 miles. It is also proposed to build from Los Angeles east to Chino, 28 miles. The road, which is a narrow gage, at present extends from Los Angeles to Redondo, 17.7 miles. Pres., Daniel McFarland, Los Angeles, Cal.

STREET AND ELECTRIC RAILWAYS.

MALDEN, MASS.—The Malden, Melrose & Stoneham St. Ry. Co. has petitioned the council for right of way on Highland Ave. for the purpose of connecting with the West End road to Boston. G. F. Butterfield, Stoneham, is interested.

WORCESTER, MASS.—The Clinton St. Ry. Co. is discussing the question of constructing a power house of its own and of purchasing closed cars.

NARRAGANSETT PIER, R. I.—Efforts are being made to secure an electric railway to connect with Watch Hill and Providence.

SYRACUSE, N. Y.—The Syracuse & East Side Ry. Co. has purchased the franchise of the Syracuse & Eastwood Height Ry. Co. Surveys are being made of the entire route from this city to De Witt, a distance of about 10 miles, and it is expected that construction will begin in October. Engrs., Mather & Allen, Kirk Bldg., Syracuse.

WOODBURY, N. J.—The construction of the proposed extension of the Camden, Gloucester & Woodbury Electric R. R. to Mantua, Pitman Grove and Glassboro, is reported as about decided upon.

CASTANEA, PA.—Surveys are being made by Charles Bell for an electric railway.

LANCASTER, PA.—The Lancaster & Susquehanna Ry. Co. has been incorporated to construct an electric railway from this city to Marietta, a distance of 14 miles; capital stock, $100,000; Pres., J. S. Graybill; directors, W. B. Given, Columbia; H. L. Haldeman, Marietta.

PITTSBURG, PA.—It is reported that arrangements for an electric railway from McKeesport to this city are being made. The plant of the McKeesport & Reynoldton Electric Ry. Co. has been sold to a syndicate for $370,000, which has also purchased the White Traction Co.'s line.

TROY, PA.—Plans are being discussed for an electric railway between this place and Towanda, a distance of 22 miles; estimated cost, with equipment, $475,000. W. W. Hess, Gen. Man., Car Equipment Co., Philadelphia, is interested.

AKRON, O.—The Cleveland & Akron Electric Ry. Co. has been granted a franchise for a line through Cuyahoga county. Secy., F. M. Chandler, Cleveland.

INDIANAPOLIS, IND.—The Indianapolis, Anderson, Alexandria & Marion Electric Ry. Co. has been incorporated; capital stock, $100,000; directors, F. M. Dice, V. C. Quick, C. A. Miller.

HARTFORD, IND.—The Hartford Electric St. Ry. Co. has been incorporated with a capital stock of $10,000 by G. E. Reynolds and Albert Reynolds.

LUDINGTON, MICH.—The Citizens' Development Co. has petitioned the council for a 30-year franchise for a street railway.

PORT HURON, MICH.—The City Electric Ry. Co. has sold bonds for the construction of its proposed road to the city limits.

CHICAGO, ILL.—The Chicago Inter-Urban St. R. R. Co. has been incorporated with a capital stock of $1,000,000, by E. H. Plummer, Ellsworth Anson and G. P. Taylor.

PORTAGE, WIS.—A proposition has been made the council for a street railway.

LYONS, IA.—The Electric Ry. & Park Co. has been incorporated with a capital stock of $50,000; Pres., E. C. Walsh; Vice-Pres., D. Langan; Secy., C. C. Coan; Treas., A. L. Stone. The line will be constructed to Joyce's Park, a distance of two miles.

ST. LOUIS, MO.—The committee on streets and railroads has decided to recommend favorably the proposed extension of the Citizens' R. R., and the changing of the motive power from cable to electricity.

TACOMA, WASH.—A company has been organized to construct an electric railway from this city to Sumner and Puyallup. Col F. C. Ross is interested.

HIGHWAYS.

KENTUCKY.—At a recent meeting of the county court of Cumberland county at Burksville a new road system was adopted, under which there will be a poll and property tax levied and collected in the same manner as the regular state and county levy is collected. A superintendent and overseers will still be maintained as under the old law. The county will be divided into road districts and contracts let to the lowest bidder to keep up the roads in each district. No tax was levied, but will be at the next term of the fiscal court, which meets in October.

OHIO.—Bids are asked until Sept. 22 for macadamizing Kennedy Ave. in Hamilton county. G. C. Zimmerman, Clk., Cincinnati.——Bids are asked until Oct. 1 for macadamizing Woodland Ave. in Franklin county. H. J. Caren, County Audr., Columbus.

MANITOBA.—The government engineer has decided to report in favor of constructing a road to be three miles long from the Louise bridge through Kildonan to connect with a main highway from North Springfield.

BRIDGES.

CONCORD, N. H.—W. B. Howe, Cy. Engr., writes us that the following bids were received Sept. 3 for the construction of the Horse Hill bridge:

Edge Moor Bridge Wks.	$5,100
Massillon Bridge Co.	4,800
Toledo Bridge Co.	4,150
Groton Bridge & Mfg. Co.	4,339
Berlin Iron Bridge Co.	5,445
Vermont Construction Co.	4,620
Boston Bridge Wks.	4,187
King Bridge Co.	4,866
Wrought Iron Bridge Co. (awarded contract)	3,685
R. F. Hawkins	4,593
Penn Bridge Co.	4,649
N. J. Steel & Iron Co.	4,546

SALEM, MASS.—Bids are being asked until Sept. 17 by the Essex county commissioners for the stone and earthwork for the westerly abutments of Rocks bridge over the Merrimac River between Haverhill and West Newbury. C. A. Putnam, Engr.

DANSVILLE, N. Y.—The White bridge over the Canaseraga Creek was burned last week.

NEW BRUNSWICK, N. J.—Bids are asked until Oct. 3 for rebuilding a bridge, as stated in our advertising columns. Michael Welsh, Dir. Bd. Freeholders.

MURPHY, N. C.—W. M. West, Chn. County Comrs., writes us that the contract for the bridge across the Hewassee River at this place has been awarded to the Columbus Bridge Co., Columbus, O., at $3,650 for a single-span bridge with double tracks and one 6-ft. sidewalk.

CLEVELAND, O.—Bids are asked until Oct. 4 for the construction of an iron and steel bridge over the Cuyahoga River at Columbus St. J. H. Farley, Dir. Pub. Wks.

JOLIET, ILL.—Bids are asked until Sept. 17 for building a steel bridge across Hickory Creek at Miller Ave., 120 ft. in length. O. R. Rauchfuss, Cy. Engr.

ALBION, MICH.—Bids are asked until Sept. 18 for a steel bridge, as stated in our advertising columns. F. Laberteaux, Cy. Clk.

DULUTH, MINN.—A. P. Boller, New York, is reported as preparing plans for the early construction of the proposed bridge to be built by the Duluth-Superior Bridge Co.

SACRAMENTO, CAL.—The board of supervisors has received the following bids for the construction of the bridge over the Consumnes River at this place: Darby, Laydon & Co., San Francisco, steel truss bridge, $17,700; San Francisco Bridge Co., $8,487 to $20,987; Cotton Bros. & Co., Oakland, $8,998 to $11,500; trestle work at $4.50 per lin. ft. extra; Healey, Tibbets & Co., San Francisco, $6,297 to $8,682; T. D. Warwick, San Francisco, $7,790 to $15,830; D. McMahon & Sons, San Francisco, $8,000 to $10,000.

PETERBORO, ONT.—Bids are asked until Sept. 19 for the construction of a steel bridge, three spans averaging 110 ft. each, over the Otonabee River near this place. John F. Belcher, County Engr.

SOREL, QUE.—The citizens of this place are trying to secure government aid for the immediate construction of an iron bridge across the Richelieu River at this place, at an estimated cost of $250,000.

WATER-WORKS.

SOMERSWORTH, N. H.—The committee has reported plans for municipal works estimated to cost, exclusive of the present plant, $76,182; supply from Salmon's Falls River, the pumping plant to be so arranged that a filtration plant of some kind may be added later, if necessary. Consult. Engr., William Wheeler, Boston,

ARLINGTON, VT.—It is reported that the construction of works has been commenced under the direction of H. S. Wilson.

MORRISVILLE, VT.—A. R. Dow, Burlington, is making surveys for the proposed new works to be owned by the village.

ADAMS, MASS.—F. H. B. Munson, Town Clk., writes us that a committee was appointed Sept. 8 to report Sept. 29 upon advisability of pumping station, artesian wells or otherwise increasing the supply, which is at present inadequate.

CAMBRIDGE, MASS.—The three lowest bids for constructing the new reservoir were as follows: P. A. Malone, Lancaster, Pa.—Plan A, $127,444; plan B, $124,282; plan C, $146,638; plan D, $145,998. Clement & Hegeman, New York—A, $127,589; B, $128,857; C, $148,569; D, $152,693. Weaving, Booth & Parry Bros., Cambridge—A, $163,905; B, $151,517; C, $190,407; D, $179,346. The itemized bids will probably be published next week. L. M. Hastings, Cy. Engr.

GREENFIELD, MASS.—The committee has voted to employ an engineer to secure estimates for a proposed increased supply.

HATFIELD, MASS.—W. H. Dickman, D. W. Wells and O. Belding, have been appointed a committee to investigate the question of a water supply and to report Oct. 1.

SALEM, MASS.—The mayor has signed an order appropriating $74,000 for an additional supply.

WINTHROP, MASS.—There is talk of organizing a water company.

LIME ROCK, CONN.—D. F. Warner, Salisbury, Pres. Lime Rock Water Co., writes us that gravity works are proposed; supply from a stream at an elevation of 250 ft. above the village; estimated cost, $25,000; no contracts yet awarded.

THOMPSONVILLE, CONN.—The Thompsonville Water Co. is extending its mains to Suffield, and will soon extend its service to Longmeadow, Mass., the town having voted to take 37 hydrants.

AFTON, N. Y.—The "Enterprise" is agitating the question of works

BUFFALO, N. Y.—Bids are asked until Sept. 20 for 100 tons of pig lead. R. G. Parsons, Secy. Dept. Pub. Wks.

CATTARAUGUS, N. Y.—Bids are asked until Sept. 29 for furnishing materials and also for constructing works. O. C. Rich, Secy. Comrs.

COHOES, N. Y.—The board has voted to purchase a 3,500,000-gallon Holly pumping engine.

EDWARDS, N. Y.—Bids are asked for a 17 × 35-ft. iron or steel stand-pipe; also for the purchase of $4,500 in 20-year 4% bonds. Dr. D. M. Taylor.

JOHNSTOWN, N. Y.—J. J. Buchanan, Supt., writes us that George Yost is preparing plans and specifications for new works.

KINDERHOOK, N. Y.—The citizens are considering the question of works.

MORRISVILLE, N. Y.—Bids are asked until Sept. 28 for constructing works, as stated in our advertising columns. Engrs., The Stanwix Engineering Co., Rome, N. Y.

NORTH TARRYTOWN, N. Y.—The power house and pumping station of the Pocantico Water-Works Co. was burned Sept. 9, causing a loss of about $15,000. This company supplies several towns along the Hudson River.

RED CREEK, N. Y.—J. H. Smith, Village Clk., writes

us that no plans for works have yet been completed; population, 900.

RICHVILLE, N. Y.—It is stated that works will be put in unless the estimate is found too high.

TONAWANDA, N. Y.—J. B. Snow, Cy. Engr., writes us that the contract for constructing the intake pier has been awarded to Jas B. Donnelly, Buffalo, at $7,306 for oak. The bids include removing the old crib, about 4 ft. of dredging and building and placing the new crib, the dimensions of which are 80 × 20 × 23 ft.; the substructure to be built either of oak or Norway pine timber for 16½ ft., masonry to start 18 ins. below the river level and be 6½ ft. high. The approximate quantities are 90 M. ft. of timber, mostly 10 × 10 ins., 21,000 lbs. ½-in. boiler iron plate, 10,000 lbs. 28-in. drift bolts, 1,000 lbs. 5-in. spikes, 370 cu. yds. stone filling, 100 cu. yds. ashlar masonry. The bids were as follows:

	Oak.	Pine.
James Lester, Tonawanda, N. Y.	....	$9,189
Hodgson & Woods, Buffalo	9,750	$8,800
James B. Donnelly, Buffalo	7,306	7,826
Sogie & Seh, Buffalo	7,497	7,747
Wm. B. Wilson, Buffalo	8,500	6,995
Gipp & Stafford, Tonawanda	8,275	7,275
E. H. Rogers, Jr., Tonawanda	8,175	7,690

BAYONNE, N. J.—The mayor has approved a 25-year contract for a supply from wells on Staten Island.

JERSEY CITY, N. J.—It is reported probable that new dam 40 ft. high for the Archibald Water Co.

LINDEN, N. J.—The Linden Water Co., recently incorporated by Jere Dunn, F. A. Thompson and others, is reported as taking steps to put in works.

ARCHIBALD, PA.—Plans are being prepared for a new dam 04 ft. high for the Archibald Water Co.

BEAVER FALLS, PA.—The council has engaged Jas. H. Harlow & Co., Pittsburg, as consulting engineers for the construction of the new works, estimated to cost, $125,000.

BEAVER FALLS, PA.—Bids are asked until Oct. 2 for pipe, hydrants, laying 20 miles of pipe, etc., until Oct. 15 for pumps and reservoir, and until Nov. 6 for a filter plant, as stated in our advertising columns. Engrs., James H. Harlow & Co., Pittsburg.

CASHTOWN, PA.—A company is being organized and has purchased a spring and 13 acres of land.

MACUNGIE, PA.—John Erdman, Secy. Council, writes us that the contract for works has been awarded to Fred Dunlap, representing J. Thompson & Co., Philadelphia, at $9,840, not including reservoir.

WERNERSVILLE, PA.—Geo. W. Wagner will apply for a charter for the Wernersville Water Co., capital stock $15,000, which proposes to put in works.

WILMINGTON, DEL.—The chief engineer has been directed to secure proposals for a carload of 4-in. pipe.

PETERSBURG, VA.—The contract for the construction of a high-service reservoir has been awarded to Lane & Bros., at $4,950. W. J. Wade, Richmond, was awarded the contract for trenching at 8¼ cts. per lin. ft., for 13,250 ft. of trench 3 ft. wide and 4 ft. deep. The city will buy and lay the pipe.

RICHMOND, VA.—The committee has recommended that the council appropriate $15,000 for the purchase of meters.

AUGUSTA, GA.—It is reported that the construction of new works will be commenced early next year; supply from Lake Olmstead, with reservoirs in the sand hills.

GRIFFIN, GA.—The council is about to contract for a stand-pipe or for a tank.

CONNERSVILLE, IND.—The residents of East Connersville have voted to put in a stand-pipe and secure a supply from driven wells. W. L. Jackson is a member of the committee to secure estimates.

LIBERTY, IND.—It is stated that the citizens are in favor of works, estimated to cost about $15,000.

NEW HAVEN, IND.—The contract for laying about a mile of mains for works has been awarded to Ryan & Surrell, plumbers, of Fort Wayne, according to press reports.

WINCHESTER, IND.—It is reported that the construction of works will be commenced as soon as plans can be decided upon. W. S. Diggs, Mayor.

FLUSHING, MICH.—Works will be put in, according to reports.

QUINCY, MICH.—C. T. Brooks, Jackson, Mich., is reported to have secured the contract for constructing works, at $16,000.

RICHMOND, MICH.—Efforts are being made to secure works.

AUSTIN, ILL.—The Upper Cicero Water & Light Co. has been incorporated with a capital stock of $50,000, by Lawrence Crook, Joseph Forchinbaur, Revere Lincoln, G. M. Andrews and others.

CHICAGO, ILL.—Bids are asked until Sept. 18 for a supply of hydrants and stop-valve castings. H. J. Jones, Comr. Pub. Wks.

ELKHORN, ILL.—A site for works is reported to have been purchased.

GRANTSBURG, WIS.—W. R. Maxwell writes us that bids will be asked for constructing works after the village sells $5,500 of 20-year bonds to pay for the same. Works will include a 1,000-bbl. tank, steam pump, 17 or 18 hydrants, 6,000 ft. of mains, etc.

KAUKAUNA, WIS.—John L. Hotchkins has been granted a franchise for works, including nine miles of mains and 90 hydrants, for which the city will pay an annual rental of $5,600.

LANCASTER, WIS.—The citizens have decided to put in works estimated to cost about $20,000.

ALTON, IA.—A. A. Richardson, Consult. Engr., Lincoln, Neb., writes us that the following bids were received Aug. 28 for constructing works, besides a large number of bids on parts of the work:

C. W. Hubbard, St. Paul	$9,363
J. W. Winchel, Le Mars (awarded contract)	10,197
Iowa Construction & Mfg. Co., Sioux City	10,028

BATAVIA, IA.—There is talk of constructing works.

DAYTON, IA.—The citizens have voted to put in works and contracts will be awarded as soon as a water supply has been secured.

EAGLE GROVE, IA.—The citizens have voted to issue $10,000 in bonds for works.

MONTEZUMA, IA.—The question of works is being discussed.

SIGOURNEY, IA.—It is stated that works will be put in.

SIOUX CITY, IA.—Bids were opened Sept. 11 for the purchase of $90,000 in 2½% water bonds.

TRAER, IA.—W. J. Ladd, Recdr., writes us that the following bids were received for constructing works:

Smedley Mfg. Co., Dubuque	$9,102
Challenge Wind Mill & Feed Mill Co., Batavia	8,848
Jackson & Moss, Fort Madison, Ia	8,816
U. S. Wind Engine & Pump Co., Batavia, Ill.	8,446

AVOCA, MINN.—Bids are asked until Sept. 15 for the purchase of $3,000 in water bonds. P. O. Opsahl, Village Recdr., writes us that works will be put in, including a 1,500-bbl. tank upon a 75-ft. tower, 600 ft. of mains and 5 hydrants.

ELYSIAN, MINN.—The citizens have voted in favor of works.

FULDA, MINN.—J. A. Maxwell, Cy. Recdr., writes us that the following bids were received for constructing works:

Tobin, Gleason & Smith, Minneapolis (aw'd con't)	$7,762
Mr. Hubbard, Sioux City	7,884
Fairbanks, Morse & Co., St. Paul	8,559
J. M. Manser, Tracy, Minn.	8,237

RUSHFORD, MINN.—F. A. Olson informs us that the contract for constructing works has been awarded to Crane & Ordway Co., St. Paul, at $5,838.

WAKEFIELD, NEB.—The contract for works has been awarded to the Iowa Construction & Mfg. Co., Sioux City, at $6,800, work to be paid for in 6% water bonds at par.

SALISBURY, MO.—The "Press" urges that works be put in; estimated cost, $12,000.

DALLAS, TEX.—Bids are asked until Oct. 3 for constructing a dam, retaining wall and pump pit, with foundation piers for vertical pump, as stated in our advertising columns. R. W. Havens, Cy. Engr.

STEPHENVILLE, TEX.—The council has voted to issue bonds for works, electric lights and an ice plant, and is reported as negotiating with Fort Worth parties for the construction.

COLORADO SPRINGS, COLO.—The council has voted to issue $70,000 of additional water bonds, a part of which will be used to complete the works.

FLORENCE, COLO.—The company having the franchise for works is reported as making the necessary surveys.

VICTOR, COLO.—Wm. J. Gower, Acting Mayor, writes us that the city intends to put in gravity works.

OAKESDALE, WASH.—The council has voted to issue $28,000 in light and water bonds.

LAMANDA PARK, CAL.—S. P. Jewett, Pres. and Engr., Lamanda Park Water Co., writes us that the company will issue $10,000 in bonds for extensions, the work to be done by the company.

GENESEE, IDAHO.—R. Pickering writes us that specifications for new works, to be owned by the city, are not yet completed; supply from well.

SUMMERSIDE, P. E. I.—Wm. Heard, Charlottetown, delivered a lecture last week on "Water-Works for Summerside," but R. Hunt, Chn. Council, was reported as stating that no steps had been taken to secure works.

AYLMER, QUE.—The town clerk writes us that at an election Aug. 31 and Sept. 1 the citizens defeated the proposition to issue $35,000 in bonds for works, and the council is now considering a petition for a franchise.

ARTESIAN WELLS.

AUSTIN, ILL.—Ed. S. Austin, Town Clk., writes us that the contract for drilling and casing the deep well at Berwyn was awarded to F. M. Gray, Milwaukee, at $4,515. W. H. Gray & Bro., Chicago, bid $4,550.

BLOOMINGTON, S. DAK.—An election will be held in Mix county, Sept. 18 to vote on the question of boring nine artesian wells at an estimated cost of $4,000 each.

IRRIGATION.

ELWOOD, NEB.—This (Gosper) county has voted $90,000 irrigation bonds, and will commence this week building irrigation ditches. The work will be done only by residents of the county.

PUEBLO, COLO.—Bids are asked until Sept. 20 for cleaning the Bessemer Irrigation Ditch Co.'s ditch, the work requiring 30,000 to 50,000 cu. yds. of work. C. K. McHarg, Secy.

PHOENIX, ARIZ.—The receiver of the Gila Bend Reservoir & Irrigation Co., the Arizona Construction Co. and the Peoria Canal Co., allied corporations, sold the property at public sale Aug. 28 for $900,000. This concludes a long period of litigation and the ultimate pushing of the enterprise. The property was purchased by the Colorado Canal & Land Co., incorporated at this city, and composed of Peoria capitalists.

NEW COMPANIES.—Wallace County Irrigation & Agricultural Association, Wallace, Kan.; capital stock, $5,000; directors, James Teele, Geo. R. Allaman, M. T. Griggs, W. J. Jordan and H. A. Clark.

SEWERS.

MEDFIELD, MASS.—The committee has received the following bids for constructing the sewerage and drainage system and making water main connections at the insane asylum: Collins & Ham, Boston, $38,918; Gennaro, Long & Little, South Braintree, $38,500; Andrew Carberry, East Walpole, $28,000; C. H. Eglee, Flushing, N. Y., $23,000.

NEW HAVEN, CONN.—The construction of a sewer or open ditch 2,000 ft. long is being discussed by the committee.

WEST HARTFORD, CONN.—The construction of a proposed system is being discussed by the selectmen. F. C. Whitmore and H. C. Judd are interested.

BUFFALO, N.Y.—The board of public works has been directed to advertise for bids for constructing a 15 and 12-in. pipe sewer in Main St.—The contract for constructing a 30-in. brick and 15 to 10-in. pipe sewer in Sussex St. has been awarded to Christopher Smith, at $12,300.

CAZENOVIA, N. Y.—Bids will soon be asked for constructing a system of sewers, including about seven miles of 18 to 6-in pipe, 26 flush tanks, 77 manholes, etc. J. A. Loyster, Clk. Comrs., writes us that there will be but little deep cutting and it is not expected that either water or rock will be encountered in the trenching; estimated cost, $38,000; Engrs., Stanwix Engineering Co., Rome.

ELMIRA, N. Y.—The council has adopted resolutions for constructing 20 to 12-in. pipe sewers in six streets. A. J. Watson, Chn. Com.

NIAGARA FALLS, N. Y.—It is reported probable that new bids will be asked for the construction of the trunk sewer, recently advertised.

NYACK, N. Y.—An election will be held Sept. 18 to vote on the question of constructing a system, estimated to cost $48,000 to $65,000.

ROCHESTER, N. Y.—The following bids have been received for a pipe sewer in Vincent Place; estimated cost, $2,500; Lauer & Hagaman, $1,862; William Fuller, $2,016; Whitmore, Rauber & Vicinus, $2,241; Brayer & Albaugh, $2,406; Chambers & Casey, $2,434.

BOUND BROOK, N. J.—H. M. Herbert, Engr., informs us that the following bids were received Sept. 4 for constructing sewers:

Jones & Wallace, Philadelphia	$23,500
*Maguire, McKnight & Co., Buffalo	19,140
Bernard Brady, Plainfield	22,386
John Shields, Flemington	20,583
Joseph Hendler, Wilkes Barre	20,708
S. Ayer, Jr., Bound Brook	20,900
Headly & Christie, Newark	19,719
P. H. & W. Rehill, Jersey City	40,252
Joseph Gallow & Co., New York	22,000
Engineer's estimate	20,405

* Awarded contract.

The itemized bids will be published in a later issue.

ELIZABETH, N. J.—Bids are asked until Sept. 28 for constructing 1,200 ft. of 18 to 12-in. pipe sewers. N. K. Thompson, St. Comr.

JERSEY CITY, N. J.—Bids are asked until Sept. 17 for constructing 3,405 ft. of 30 to 20-in. brick sewers. G. T. Bouton, Clk. Bd. St. Comrs.

PLAINFIELD, N. J.—The contract for sewers, as recently advertised, has been awarded to W. W. Cook & Co., Jamestown, N. Y. The itemized bids are published under Contract Prices.

ERIE, PA.—The city engineer has estimated the cost of constructing a 36-in. brick sewer in Ash St. at $23,444, and a 24-in. pipe sewer at $12,407.

PHILADELPHIA, PA.—The contracts for constructing the subway sewers have been awarded as follows: 24th St. and Pennsylvania Ave. system, Ryan & Kelly, $102,000; J. A. Mundy & Bro., $138,000; Callowhill St. system, C. P. Grim & Co., $94,000; G. W. Ruch, $75,000; John McCann, $47,000, who also was awarded the contract for the 12th St. system at $25,000.

MONTGOMERY, ALA.—The contracts for constructing the sewers recently noted have been awarded to Dunn & Lalland Bros., Cleveland, O., at $67,438, the bids being as follows, (1) being the Catoma and Moulton St. work and (2) the sewers in Union and Decatur Sts.:

	1.	2.
Davis Bros.	$56,037	$74,875
J. A. L. Minor & Co.	29,676	41,894
Dunn & Lalland Bros.	29,132	38,307
South Bend Cons. & Imp. Co.	40,206	55,128
Garey & Fahey	37,230	47,491
McAuley & Bryning	34,251	46,349
Howard Neely	30,091	39,600
Lane Bros. & Co. & Watkins & Hardaway	32,325	44,904
Greenville Construction Co.	31,049	43,382

LEXINGTON, KY.—The committee is considering the plans of Col. G. E. Waring for a system.

BATTLE CREEK, MICH.—The board of public works estimates the cost of constructing 3,000 ft. of 54 to 20-in. brick and 1,030 ft. of 12 to 8-in. pipe sewers in five streets at $15,691.

JOLIET, ILL.—Contracts were awarded last week as follows; Cy. Engr., O. R. Rauchfuss: Campbell & Dennis, Exchange St. sewer, $2,500; Spring St. sewer, $5,200; Elwood St. sewer, $3,300; Columbia St. sewer, $2,500; McDonough St. sewer, $542; Patrick McHugh, Cass St. sewer, $970; Ross St. drain, $1,000; Morrison & McCowan, McDonough St. drain, $2,500; Exchange St. wall, $3,000; Isaac Johnson, slough drain, $1,500; R. C. Morrison, Ohio St. bridge, $926; Washington St. bridge, $1,285.

OCONTO, WIS.—Plans for a system have been completed by W. F. Goodhue, Milwaukee.

COLORADO SPRINGS, COLO.—The council has voted to construct at once a sewer, estimated to cost $20,000.

STREETS.

NEW HAVEN, CONN.—The council has been petitioned to pave 23 streets with asphalt and 17 streets with granite blocks, estimated to cost about $1,000,000. F. C. Bushnell is interested.

BINGHAMTON, N. Y.—Bids are asked until Sept. 24 for paving with asphalt upon a concrete foundation. Lewis Seymour, Cy. Clk.

ROCHESTER, N. Y.—The following bids have been received for macadamizing Culver road, estimated cost, $21,500: Chambers & Casey, $15,774; Gilbert, Brady & Co., $16,601; William H. Jones & Sons, $17,871; Wm. Fuller, $17,891; R. Y. McConnell, $18,437; Lauer & Hagaman, $18,982; Whitmore, Rauber & Vicinus, $19,309; Brayer & Albaugh, $19,686.

SYRACUSE, N. Y.—The following bids have been received for paving two streets with brick: G. D. Grannis, $18,859, $31,915; Homer & Co., $17,192, $31,535; A. F. West, $17,328, $32,782; L. D. Hulbert, $30,803.

NEWARK, N. J.—Bids are asked until Sept. 20 for 2,900 sq. yds. of granite block paving on 6 ins. concrete foundation. J. C. Mundy, Gen. Supt. of Wks.

WASHINGTON, D. C.—The commissioners have decided to construct cement and brick sidewalks, etc., estimated to cost about $90,000.

LOUISVILLE, KY.—Bids are asked by the board of public works until Sept. 17 for improving portions of 26 streets.

SPRINGFIELD, O.—The city engineer has been directed to prepare plans for paving Center St.

TOLEDO, O.—Bids are asked until Sept. 24 for paving three streets with Trinidad Lake asphalt, brick or cedar blocks, and until Oct. 1 for paving three streets with the same materials. L. P. Harris, Cy. Clk.

LOGANSPORT, IND.—The council has voted to pave Fourth St. with brick. Albert Swadener, Cy. Clk.

DETROIT, MICH.—The board of public works has received the following bids for paving between car tracks with brick: Archie Grant, $30,682; John McLoughlin, $1.64 per sq. yd.; Thomas Currie, $32,095; Sheehan & Co., $34,169; Patrick Dee, $32,182; Henry Frederick, $28,545.

PORT HURON, MICH.—Bids are asked until Sept. 15 for 3,400 sq. yds. of brick paving on 6 ins. concrete. F. F. Rogers, Cy. Engr.

ST. PAUL, MINN.—The board of public works has received the following bids for paving two streets with asphalt:

	Sibley St.	Fourth St.
Trinidad Asphalt Paving Co.	$12,200	$17,993
Western Asphalt Co.	12,000	17,300
Warren-Scharf Asphalt Paving Co.	11,440	17,087
Hennessey Bros. & Co. (aw'd con.)	11,044	16,807

OMAHA, NEB.—The city clerk has been directed to advertise for bids for repaving Oakland Ave. with brick.

HALIFAX, N. S.—Bids are asked until Sept. 17 for 2,400 sq. yds. of asphalt sidewalks. F. W. W. Doane, Cy. Engr.

ELECTRIC LIGHT AND POWER.

SARANAC LAKE, N. Y.—Blood, Murray & Mason have purchased the Branch & Callanan water power plant for $5,500 and will put in an electric light plant, having secured a franchise for five years.

ALLEGHENY, PA.—The board of public works received the following bids for the extension of the municipal electric light plant: Western Electric Co., $70,770; Wayne Electric Co., $71,626; Westinghouse Electric Co., $73,832. Contracts were awarded as follows: Babcock-Wilcox Co., two 250-HP. boilers, at $23,343; Ball Engine Co., five engines, at $15,000, and the Westinghouse Electric Co., at $34,095.

KENSINGTON, PA.—It is stated that arrangements are being made for putting in an electric light plant. Sidney Fuller, Du Bois, and D. W. Weyman, Tarentum, are interested.

MECHANICSBURG, PA.—The council has voted to put in an electric light plant.

WYTHEVILLE, VA.—The council has transferred the electric light plant to A. E. Coulter, who will supply the town with electricity and also construct a street railway.

JACKSONVILLE, FLA.—The board of public works received the following bids for a complete electric light plant, estimated to cost $75,000: Fort Wayne Electric Light Co., $74,800; Standard Electric Co., Chicago, $64,792, and Robinson & Patrick, Macon, Ga., $63,875; and also a large number of bids for parts of the work.

DAYTON, O.—The board of trade has recommended that the city construct and operate its own electric light plant. The city at present pays the Dayton Electric Light Co. $125 a year for each lamp for street lighting.

SEYMOUR, IND.—The construction of a municipal electric light plant is being discussed.

SPOKANE, WASH.—A resolution has been introduced into the council for constructing an electric light plant, estimated to cost $75,000, in connection with the water-works.

ST. HELEN'S, ORE.—An electric light franchise for 10 years has been granted

NEW COMPANIES.—Chateaugay Electric Light & Power Co., Chateaugay, N. Y.; $6,000; E. A. Douglass, H. G. Douglass.——Norwood Electric Light & Power Co., Norwood, N. Y.; $5,000; G. W. Richards, W. D. Fuller, F. L. Smith.——Middletown Electric Light & Power Co., Middletown, O.; $40,000.——Electric Construction Co., Cleveland, O.; $10,000; E. H. Fishack, T. J. Carmack, Robert McNauli.——United States Electro-Magnetic Co., Chicago, Ill.; $250,000; F. S. Lenert, A. V. Conle.——American Electric Exercising Machine Co., Chicago, Ill.; $50,000; J. W. Williams, H. J. Weld.——Brown's Electric Supply Co., Minneapolis, Minn.; C. D. Brown, P. W. McAllister.——Upper Cicero Water & Light Co., Austin, Ill.; $50,000; Lawrence Crook, Revere Lincoln.——Coalport-Irvona Light, Heat & Power Co., Coalport, Pa.; $10,000; Treas., W. F. Wagner.——Suburban Electric Light Co., Scranton, Pa., $100,000.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

HARBOR IMPROVEMENTS.—Philadelphia, Pa.—Mayor Stuart has recommended an appropriation of $1,500,000 for harbor improvements.

ROCK AND LUMBER.—New Orleans, La.—Bids are asked until Sept. 20 for 10,000 tons of rock and until Sept. 25 for a supply of lumber. Capt. John Millis, U. S. Engr. Office.

JETTIES.—Savannah, Ga.—Bids are asked until Sept. 29 for constructing jetties at Cumberland Sound, Ga., as stated in our advertising columns. Capt. O. M. Carter, U. S. Engr. Office.

IRON STAIRS, ETC.—Washington, D. C.—The lowest bid for furnishing iron stairs, etc., for the U. S. public building at Newark, N. J., was that of Brown, Ketcham & Co., Indianapolis, at $19,509.

ELECTRIC FIXTURES, SKYLIGHTS, ETC.—Denver, Colo.—Bids are asked until Oct. 5 for gas and electric fixtures, and glass for skylights for the new capitol building. Herman Lueders, Secy. Bd.

CANAL WORK.—Los Angeles, Cal.—Bids are asked in our advertising columns, by French & Reed, railway and grading contractors, of this city, for 1,508,000 cu. yds. of work on the Jaqui canal, in Sonora, Mex.

LIGHTHOUSE LANTERN.—Tompkinsville, N. Y.—Bids are asked until Sept. 26 for a lantern for Bridgeport breakwater lighthouse, as stated in our advertising columns. Maj. D. P. Heap, U. S. Lighthouse Engr.

COURT HOUSE.—Chicago, Ill.—Bids are asked by the commissioners of Cook county until Sept. 26 for the construction of a new county court house; amount of surety, $2,500,000. C. Mamer, Supt. Public Service.

CANAL IMPROVEMENTS.—Albany, N. Y.—Bids are asked until Sept. 19 for repairs to Madi'son Brook feeder, Lebanon feeder, and the summit level of the abandoned Chenango Canal. C. W. Adams, State Engr.

STATION HOUSE, CELLS, ETC.—Brooklyn, N. Y.—Bids are asked until Sept. 17 for erecting a station house, cells building and patrol stable on the northeast corner of Hamburg Ave. and De Kalb Ave. A. T. White, Comr. Cy. Wks.

RIVER AND HARBOR WORK.—Chicago, Ill.—Bids are asked until Sept. 25 for work in Chicago and Calumet harbors and for dredging in Calumet River, as stated in our advertising columns. Capt. W. L. Marshall, U. S. Engr. Office.

RUBBLE STONE AND DREDGING.—Boston, Mass.—Bids are asked until Oct. 8 for delivering rubble stone at Scituate Harbor, Mass., and for dredging in Weymouth River, Mass., as stated in our advertising columns. Lieut.-Col. S. M. Mansfield, U. S. Engr. Office.

WATER POWER CANAL.—Model City, N. Y.—Bids are asked until Oct. 1 for constructing a power canal for the Niagara Power & Development Co. The work will be let in eight sections, each 5,000 ft. in length, and will require about 1,300,000 cu. yds. of earth and 4,300,000 cu. yds of rock excavation, as stated in our advertising columns. E. C. Reynolds, Ch. Engr.

OPERATING MACHINERY.—Detroit Mich.—The following bids were received by Col. O. M. Poe, U. S. Engr. Office, Sept. 5, for operating machinery for the 800-ft. lock, St. Mary's Falls Canal, Mich.:

John P. McGuire, Cleveland, O.	$59,400
Weimer Machine Wks. Co., Lebanon, Pa.	66,701
Southwark Foundry & Machine Co., Philadelphia	81,600
Thos. S. Christie, Detroit, Mich.	96,225

GARBAGE CREMATORIES.—St. Paul, Minn.—The joint committee on garbage is investigating a proposed crematory estimated to cost $15,000. It is stated that it would cost $9,120 per year to operate the crematory and the receipts from ashes would amount to $7,300.

Braddock, Pa.—The council is reported as about to purchase a garbage crematory.

LEVEE WORK.—Memphis, Tenn.—Bids are asked until Sept. 25 for the construction of levees in the Upper Tensas levee district. Capt. C. McD. Townsend, U. S. Engr. Office.

New Orleans, La.—Bids are asked until Sept. 17 for 232,000 cu. yds of levee work on Cowpen Neck, near Natchez, Miss. Capt. John Millis, U. S. Engr. Office.

BUILDING.—Davids Island, New York Harbor. Bids are asked until Sept. 25 for the construction of two sets of officers' quarters. J. W. Summerhayes, Asst. Q. M., U. S. A.

Washington, D. C.—Bids are asked until Oct. 9 for a new building, etc., at the U. S. marine hospital, Vinyard Haven, Mass., as stated in our advertising columns. Jeremiah O'Rourke, Supervising Arch., Treasury Dept.

Washington, D. C.—Bids are asked until Sept. 27 for the construction of barracks and officers' quarters at Fort Myer, Va. Col. Geo. H. Weeks, Depot Q. M., U. S. A.

DREDGING AND FURNISHING STONE.—Washington, D. C.—Bids are asked until Oct. 4 for dredging in York River, Va., and for furnishing stone and dredging in Potomac River, as stated in our advertising columns. Maj. Chas. E. L. B. Davis, U. S. Engr. Office.

Norfolk, Va.—Bids are asked until Oct. 11 for dredging in harbor at Norfolk and in Nausemond River, Va., as stated in our advertising columns. First Lieut. Edward Burr, U. S. Engr. Office.

Pittsburg, Pa.—Bids are asked until Sept. 18 for about 63,000 cu. yds. of dredging in the Allegheny River. Capt. R. L. Hoxie, U. S. Engr. Office.

DRAINAGE WORK.—Marine City, Mich.—H. H. Butler, County Drain Comr., writes us that the contract for constructing the south branch of the Mill Creek drain, in Lapeer and St. Clair counties, has been awarded to Pollard, Goff & Co., Champaign, Ill., at 80 per rod, the other bidders being: Whitmey Dredging Co., of Kenton, O.; Behymer & Co., Celina, O.; A. V. Wills & Son, Pittsfield, Ill.; Drummond & Co., Sault de Ste. Marie, Mich.; Cook & Stephenson, Port Huron, Mich.; J. Lamb & Co., Imlay City, Mich.

WHARF WORK.—Tompkinsville, N. Y.—Maj. D. P. Heap, U. S. Lighthouse Engr., informs us that the following bids were received for removing the old and building new wharf, recently advertised:

Colin McLean, 415 Broadway, New York	$8,950
Geo. B. Inman, 136 Liberty St., New York	7,777
John A. Kelly, 62 Elizabeth St., Brooklyn	7,770
Frank Rinschler, Stapleton, N. Y.	8,500
Thos. J. Gilroy, 391 Pearl St., New York	16,740
H. M. Conklin & Co., West Brighton, N. Y.	7,200

Philadelphia, Pa.—We are informed that the contract for rebuilding and repairing wharves at U. S. naval home, this city, has been awarded to Joseph S. Allen, at $2,424, the other bids being: Geo. C. Platt, at $2,620, and I. H. Hathaway & Co., at $4,590; all residents of Philadelphia.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Sept. 14.	Pipe sewers,	Charleston, S. C.	Aug. 30
	Advertised, Eng. News, Aug. 30 and Sept. 6.		
Sept. 14.	Electric light plant,	Lancaster, Pa.	Aug. 16
Sept. 14.	W-wks system,	Hammondsport, N. Y.	Sept. 6
Sept. 14.	Electric light plant,	Kingston, N. Y.	Sept. 6
	Advertised, Eng. News, Sept. 6.		
Sept. 15.	Asphalt paving,	Cincinnati, O.	Aug. 30
Sept. 15.	Water bonds ($100,000),	Detroit, Mich.	Aug. 30
Sept. 15.	Electric light plant,	Toronto, Ont.	Aug. 30
	Advertised, Eng. News, Aug. 2 to 16.		
Sept. 15.	Water-works bonds,	Avoca, Minn.	Aug. 30
Sept. 15.	Water bonds ($100,000),	Detroit, Mich.	Aug. 16
Sept. 15.	Garbage crematory,	Ft. Wadsworth, N. Y.	Aug. 23
Sept. 15.	Brick paving,	Port Huron, Mich.	Sept. 13
Sept. 17.	Electric lighting,	Hempstead, N. Y.	Aug. 30
Sept. 17.	Pipe sewers (15,093 ft.),	Scottdale, Pa.	Aug. 30
	Advertised, Eng. News, Aug. 30 and Sept. 6.		
Sept. 17.	Sidewalks (13 contracts),	Houston, Tex.	Aug. 30
Sept. 17.	Iron hoist bridge,	Dayton, O.	Aug. 23
Sept. 17.	Brick work, etc.,	Washington, D. C.	Sept. 6
Sept. 17.	Paving,	Houston, Tex.	Sept. 6
Sept. 17.	Bridge abutment,	Salem, Mass.	Sept. 13
Sept. 17.	Station house, etc.,	Brooklyn, N. Y.	Sept. 13
Sept. 17.	Brick sewers (3,405 ft.),	Jersey City	Sept. 13
Sept. 17.	Levee work,	New Orleans, La.	Sept. 17
Sept. 17.	Street improvements,	Louisville, Ky.	Sept. 17
Sept. 17.	Steel bridge,	Joliet, Ill.	Sept. 17
Sept. 17.	Asphalt sidewalks,	Halifax, N. S.	Sept. 17
Sept. 18.	Bldg superstructure,	Washington, D.C.	Aug. 30
Sept. 18.	New channel,	Ottawa, Ont.	Aug. 30
Sept. 18.	Water-works system,	Guttenberg, Ia.	Aug. 23
	Advertised, Eng. News, Aug. 23 to Sept. 6.		
Sept. 18.	Laying water mains,	New York	Sept. 6
Sept. 18.	Sewers,	New York	Sept. 6
Sept. 18.	Stone arch bridge,	Sandusky, O.	Sept. 6
Sept. 18.	Water-wks, system,	Decatur, Ind.	Sept. 6
	Advertised, Eng. News, Sept. 6 and 13.		
Sept. 18.	Electric lighting,	Stillwater, Minn.	Sept. 6
Sept. 18.	Dredging,	Pittsburg, Pa.	Sept. 13
Sept. 18.	Hydrants, etc.,	Chicago, Ill.	Sept. 13
Sept. 18.	Steel bridge,	Albion, Mich.	Sept. 13
	Advertised, Eng. News, Sept. 13.		
Sept. 19.	Buildings,	Helena, Mont.	Sept. 6
Sept. 19.	Bridge,	Baltimore, Md.	Sept. 6
Sept. 19.	Canal improvements,	Albany, N. Y.	Sept. 13
Sept. 19.	Steel bridge,	Peterboro, Ont.	Sept. 13
Sept. 20.	Police station,	Cleveland, O.	Aug. 30
Sept. 20.	Fire engines,	Cleveland, O.	Aug. 30
Sept. 20.	Plumbing, etc.,	Washington, D. C.	Sept. 6
	Advertised, Eng. News, Sept. 6 and 13.		
Sept. 20.	Canal (4 miles),	Chicago, Ill.	Sept. 6
Sept. 20.	Pig lead (100 tons),	Buffalo, N. Y.	Sept. 13
Sept. 20.	Granite paving,	Newark, N. J.	Sept. 13
Sept. 20.	Rock (10,000 tons),	New Orleans, La.	Sept. 13
Sept. 20.	Cleaning irrig'n ditch,	Pueblo, Colo.	Sept. 13
Sept. 21.	Jail,	Ortonville, Minn.	Aug. 30
Sept. 21.	Public buildings,	Washington, D. C.	Sept. 6
Sept. 22.	Brick paving,	Cincinnati, O.	Aug. 30
Sept. 22.	Rock removal,	Detroit, Mich.	Aug. 30
Sept. 22.	Dams, etc., Rock Island,	Ill.	Aug. 30
	Advertised, Eng. News, Aug. 30 to Sept. 20.		
Sept. 22.	Macadamizing,	Cincinnati, O.	Sept. 13
Sept. 24.	Brick paving, South Bend,	Ind.	Sept. 6
Sept. 24.	Asphalt paving,	Binghamton, N. Y.	Sept. 13
Sept. 24.	Paving,	Toledo, O.	Sept. 13
Sept. 25.	Stone,	Nashville, Tenn.	Aug. 30
	Advertised, Eng. News, Aug. 30 to Sept. 20.		
Sept. 25.	Crib repairs, etc.,	Washington, D. C.	Sept. 6
Sept. 25.	Officers' quarters,	Davids Island, N. Y. H.	Sept. 13
Sept. 25.	Lumber, New Orleans,	La.	Sept. 13
Sept. 25.	Levee work,	Memphis, Tenn.	Sept. 13
Sept. 25.	Dredging, etc.,	Chicago, Ill.	Sept. 13
	Advertised, Eng. News, Sept. 6 to 20.		
Sept. 26.	Sewers,	Sandusky, O.	Aug. 30
Sept. 26.	Metal work,	Baltimore, Md.	Sept. 6
	Advertised, Eng. News, Sept. 6 and 13.		
Sept. 26.	Light station,	Baltimore, Md.	Sept. 6
	Advertised, Eng. News, Sept. 6 and 13.		
Sept. 26.	Lantern,	Tompkinsville, N. Y.	Sept. 13
	Advertised, Eng. News, Sept. 13.		
Sept. 26.	Court house,	Chicago, Ill.	Sept. 13
Sept. 27.	Buildings,	Plattsburgh, N. Y.	Sept. 6
Sept. 27.	Iron work,	Charleston, W. Va.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 20.		
Sept. 27.	Barracks, etc.,	Washington, D. C.	Sept. 13
Sept. 27.	Sewer bonds ($12,000),	Sandusky, O.	Sept. 6
Sept. 28.	Stone arch bridge,	Sandusky, O.	Aug. 30
Sept. 28.	Paving (10,174 sq.yds.),	Van Wert, O.	Aug. 30
	Advertised, Eng. News, Aug. 30 to Sept. 20.		
Sept. 28.	Water-wks. system,	Morrisville, N. Y.	Sept. 13
	Advertised, Eng. News, Sept. 6 and 13.		
Sept. 28.	Pipe sewers,	Elizabeth, N. J.	Sept. 13
Sept. 29.	Bridges,	Indianapolis, Ind.	Aug. 23
Sept. 29.	Water-wks. system,	Cattaraugus, N. Y.	Sept. 13
Sept. 29.	Jetties,	Savannah, Ga.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 1.	Electric lighting,	Vicksburg, Miss.	Aug. 30
Oct. 1.	Water power canal,	Model City, N. Y.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 20.		
Oct. 1.	Macadamizing,	Columbus, O.	Sept. 13
Oct. 1.	Paving,	Toledo, O.	Sept. 13
Oct. 2.	Electric lighting,	Jackson, Tenn.	Aug. 30
Oct. 2.	Water-wks. system,	Greenville, Mass.	Aug. 23
	Advertised, Eng. News, Aug. 23 to Sept. 13.		
Oct. 2.	Pipe, etc. (20 miles),	Beaver Falls, Pa.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 3.	Bridge, New Brunswick,	N. J.	Sept. 13
	Advertised, Eng. News, Sept. 13.		
Oct. 3.	Dam, pump pit, etc.,	Dallas, Tex.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 4.	Rubble stone (2 contracts),	Boston,	Sept. 6
	Advertised, Eng. News, Sept. 6 to 20.		
Oct. 4.	Dredging,	Boston, Mass.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 20.		
Oct. 4.	Dredging,	Washington, D. C.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 27.		
Oct. 4.	Stone, etc.,	Washington, D. C.	Sept. 13
	Advertised, Eng. News, Sept. 6 to 20.		
Oct. 4.	Dredging,	Washington, D. C.	Sept. 13
	Advertised, Eng. News, Sept. 6 to 20.		
Oct. 4.	Bridge,	Cleveland, O.	Sept. 13
Oct. 5.	Breakwater repairs,	Burlington, Vt.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 27.		
Oct. 5.	Dredging (2 contracts),	Burlington, Vt.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 27.		
Oct. 5.	Rock excavation,	Burlington, Vt.	Sept. 6
	Advertised, Eng. News, Sept. 6 to 27.		
Oct. 5.	Electric fixtures, etc.,	Denver, Colo.	Sept. 13
Oct. 8.	Rubble stone,	Boston, Mass.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 8.	Dredging,	Boston, Mass.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 9.	Buildings, etc.,	Washington, D. C.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 20.		
Oct. 11.	Dredging (2 contracts),	Norfolk, Va.	Sept. 1
	Advertised, Eng. News, Sept. 13 to Oct. 4.		
Oct. 16.	Pumps and reservoirs,	Beaver Falls, Pa.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
Oct. 19.	Jail cells, etc.,	Auburn, Cal.	Aug. 30
Oct. 31.	Drawbridges,	Chicago, Ill.	Sept. 6
	Advertised, Eng. News, Sept. 6.		
Oct. 31.	Bridge masonry,	Chicago, Ill.	Sept. 6
	Advertised, Eng. News, Sept. 6.		
Nov. 6.	Filter plant,	Beaver Falls, Pa.	Sept. 13
	Advertised, Eng. News, Sept. 13 to 27.		
No date.	Canal work,	Los Angeles, Cal.	Sept. 13
	Advertised, Eng. News, Sept. 13 to Oct. 18.		
"	" Stand-pipe,	Edwards, N. Y.	Sept. 13
"	" Water bonds ($4,500),	Edwards, N. Y.	Sept. 13

CONTRACT PRICES.

ASPHALT PAVING.—St. Paul, Minn.—The lowest bids recently received for paving three streets with asphalt were reported as follows: Fourth St.—The Warren-Scharf Asphalt Paving Co., $2.80 per cu. yd.; Seventh St.—Hennessey Bros. & Cox, $2.60; Sibley St.—Hennessey Bros. & Cox, $2.65.

ASPHALT PAVING AND GRADING.—Washington, D. C.—The following bids were received last week for paving with asphalt, according to press reports:

	Hydraulic base. 6-in.	4-in.
Thos. H. Thomas,.....per sq. yd.	$2.05	$1.85
Barber Asphalt Paving Co... " " "	2.25	2.00
Cranford Paving Co..... " " "	1.16	1.53

The Washington Asphalt Tile Co. bid $1.78 on a gravel base, and $2.25 on a concrete base. The bids for grading Massachusetts Ave. extension were as follows: E. G. Gunnel, 39½ cts. per cu. yd; Lyons Bros., 40 cts.; Andrew Gleeson, 29½ cts.; and R. G. Isreal, 22⅞ cts.

Cedar Rapids, Ia.—The contract for constructing water-works has been awarded to the U. S. Wind Engine & Pump Co., at $9,000, as stated in our issue of last week. G. H. Ellsworth, Consult. Engr., Fullerton, Neb., writes us that the prices of the bid were as follows: 8, 6 and 4-in. cast iron pipe, laid, 76, 57 and 42 cts. per lin. ft., respectively; hydrants, in place, $30; 8, 6 and 4-in. valves and boxes, in place, $24, $17 and $14; complete works, $9,000. J. A. Barris, Council Bluffs, bid 70 cts., 57 cts., 44 cts., $30, $20.25, $15, $10.25 and $9,786, respectively; F. L. Burrell, Fremont, Neb., 76 cts., 54 cts., 41 cts. (no bids for hydrants), $24, $18, $15, and $9,315; and Atkinson Bros. & Co., Colorado Springs, Colo., 80 cts., 60 cts., 45 cts., $30 (no bids for valves), and $8,887. The Fremont Foundry & Machine

CANAL EXCAVATION, ETC.—Chicago, Ill.—The lowest bids received by Capt. W. L. Marshall, U. S. Engr. Office, Aug. 27, for constructing the eastern section of the Illinois & Mississippi Canal, between mile 0 and mile 4, and for excavating the lock pits and constructing the foundations for four locks were noted in our issue of Sept. 6. The work will require 101,367 cu. yds. of excavation for the first mile, 89,324 cu. yds. for the second, 87,313 cu. yds. for the third, and 150,004 cu. yds. for the fourth mile. The price bid per cubic yard for this work and the itemized prices of the bids for lock pit and foundation for lock No. 1, and the total bids for all the lock pits and foundations were as follows; contracts for all except mile 4 have been awarded to the lowest bidders:

BIDS FOR CONSTRUCTING EASTERN SECTION OF ILLINOIS & MISSISIPPI CANAL, BETWEEN MILE 0 AND MILE 4.

	Mile.				Lock pit and foundation Lock No. 1.								
Bidder.	1. cts.	2. cts.	3. cts.	4. cts.	Earth work per cu. yd.	Piles, each.	Pine plank, per M ft.	Pine timber, per M ft.	Oak plank, per M ft.	Bolts and spikes, per lb.	Concrete, per cu. yd.	Total, lock No. 1.	Total, lock No. 2.	Total, lock No. 3.	Total, lock No. 4
John Killeen, New Liberty, Ia	20	14	12½	14	$70	$3.50	$2.00	$32.00	$65.00	$0.07	$4.90	$22,905	$35,088	$18,561	$19,984
R. L. Van Sant, St. Louis, Mo	..	....	....	....	35	4.50	23.50	23.50	35.00	0.04	3.10	13,440	14,640	12,408	12,649
J. D. Moran Mfg. & Const'n Co., St. Paul, Minn	20	15	20	20	20	30.00	30.00	40.00	40.00	0 04	2.50	26,999	27,585	26,309	27,700
Mail & Doan, Aurora, Ill	....	....	....	....	22	4.03	22.00	23.75	51.00	0.02½	2.10	10,404	11,159	9,849	10,135
Warren K. Loss, Chicago, Ill	17½	14.3	17.9	19.8	28	4.48	22.60	26.95	47.50	0.04½	4.95	14,867	15,300	13,357	13,267
Campbell & Dennis, Joliet, Ill	15	10	12½	11	18	7.25	21.00	23.00	60.00	0.04½	4.48	14,458	14,513	13,556	13,063
Conley Bros., Chicago, Ill	11.8	9.4	10.9	9.4	..	....	....	....	....	....	....	....	....	....	....
Christie & Lowe, Chicago, Ill	12	11	11 4	9.8	25	5.50	21.00	23.00	35.00	0.04	3.60	12,517	13,375	11,779	12,248
Mallory, Cushing & Co., Omaha, Neb	10	9	11	9	16	4.00	23.00	23.00	37.00	0.03	4.40	11,789	12,398	11,318	12,168
John J. McCaughey, Summit, Cook Co., Ill	....	8	....	....	..	....	....	....	....	....	....	....	....	....	....
Ford & McManus, Keokuk, Ia	12⅝	10	13	10	..	....	....	....	....	....	....	....	....	....	....
Shaller & Schmigau Co., Chicago, Ill	....	....	....	....	25	4.25	21.75	21.75	30.00	0.04	4.25	12,972	13,369	12,358	13,555
M. Lowell, Bros. & Co., Grand rapids, Mich	....	....	15½	16½	..	....	....	....	....	....	....	....	....	15,887	16,450
Kelley & Monroe, Portsmouth, O	19.9	17.7	14	12½	90	4.85	30.00	30.00	40.00	0.04	3.45	22,395	17,681	14,240	14,518
William Callahan, Omaha, Neb	9.95	5¾	14¼	9¾	28½	6.30	22.00	22.50	27.00	0.03½	4.00	14,551	11,165	10,311	13,257
Patterson & Shipman, Catlettsburg, Ky	15	15	15	14	20	4.50	25.10	25.00	45.00	0.03	3 50	11,964	12,6 0	11,146	11,807
McDonald & Penfield, Fremont, Neb	16.2	13 6	13½	12	100	8.00	28.00	28.00	32 00	0.06	5.50	27,936	40,259	22,157	25,633
Fruin Bambrick Construction Co., St Louis, Mo	19.8	18.1	21.1	22.1	39.2	6.00	30.00	24.00	40.00	0.04	5.00	17,206	17,601	14,979	16,634
Ed. Phelan, Omaha, Neb	11	8	10	9	30	4.80	19.50	23.00	45.00	0.03	4.25	14,311	14,827	12,448	13,676
Kimball & Cobb Stone Co., Chicago, Ill	....	....	12¾	9	....	....	....	....	....	....	....	....	....	....	....
N. P. Glann Construction Co., Galesburg, Ill	18.93	13.01	16.48	12.37	....	....	....	....	....	....	....	....	....	....	....
Barbour & Rupie, Cleveland, O	....	9.44	11.40	....	....	....	....	....	....	....	....	....	....	....	....
Maugan & Davis, Chicago, Ill	16¾	11½	12¼	16¼	26	6.30	19.80	22.55	52.95	0.27	4.86	15,090	15,027	13,319	15,107

LEAD.—Rochester, N. Y.—The executive board has contracted with the Rochester Lead Co. for 200,000 lbs. of pig lead to be used in the extension of water mains, at $3.30 per 100 lbs., the other bids being: Behr & Steiner, New York, $3.30; Charles Wagner, Agt., Omaha & Grant Smelting Co., St. Louis, $3.32½; M. Corwith, Chicago, $3.30; John Wahl Commission Co., St. Louis, $3.32.

ARTIFICIAL STONE PAVING.—Norristown, Pa.—Bids for artificial stone paving, opened Aug. 29, ranged from $1.39 to $1.83 per sq. yd.; 11 bidders.

Co. bid $9,250, and A. Kirwit & Co., Omaha, $9,922, for the works complete.

PAVING BRICK, ETC.—Quincy, Ill.—Bids for paving several streets with brick were rejected, as stated last week, and contracts for the work have since been awarded as follows: Furnishing 1,500,000 brick, Galesburg Paving Brick Co., at 63.3 cts. per sq. yd.; excavating the streets, J. A. Hummert, at 16¾ to 25 cts. per cu. yd.; hauling the brick, T. B. Bimson, at 46½ to 57½ cts. per 1,000; hauling sand, James Jarrett, at 17 cts. per cu. yd.; Niehaus & Menne, at 21 cts.; T. B. Bim-

SEWERS.—Plainfield, N. J.—Bids were received Sept. 5 for constructing the first section of the proposed system. We are informed that about 75 applications were received for copies of the specifications, in response to the recent notices in these columns, and that in addition to the bids given below that informal bids were received from Louis Quien & F. C. O'Reilly, Jr., Elizabeth, N. J., and H. C. N. Johnston, Passaic, N. J. Consult. Engr., F. W. Farquhar, New York; Engr. in Charge, A. J. Gavett, Plainfield. The bids were as follows, the total of each being given in under the name of the bidder:

BIDS RECEIVED AT PLAINFIELD, N. J., SEPT. 5, 1894, FOR CONSTRUCTING SEWERS.

Quantities.	W. W. Cook & Co., Jamestown, N. Y., $18,858.	Patrick McShane, Paterson, N. J., $20,038.	Nelson, Dunn & Cortese, Plainfield, N. J., $20,078.	Otis & Longyear, Kingston, N. Y., $20,303.	M. Honan, Chester, Pa., $20,855.	John H. Hurley, Trenton, N. J., $21,931.	McKnight & Co., Magnire, Buffalo, N. Y., $224,69.	Malone, Marino & Arnold, Orange, N. J., $22,461.	Bernard Brady, Plainfield, N. J., $22,945.	Jas. Smith & Son, Easton, Pa., $24,082.	Patrick Reynolds & Jas. Conway, Newark, N. J., $24,295.	Geo. McKay & Co., Philadelphia, Pa., $25,368.	Wm. Hanna & Jos. Randall, Kearney, N. J., $25,359.	Jas. J. Cogan, Bayonne, N. J., $28,447.	Hawkes & Stratford, Brooklyn, N. Y., $28,760.	T. P. Smart & Co., Philadelphia, Pa., $28,910.	Patrick T. Plunkett, Jersey City, N. J., $29,719.	Murray & Molloy, New Rochelle, N. Y., $32,380.	Bartholomew & Hathaway, Asbury Park, N. J., $35,486.	Wm. J. Smith & N. J. Conover, Spring Lake, N. J., $35,866.	Geo. R. Newman & Co., Providence, R. I., $38,000.	Thos. Redding, Perth Amboy, N. J., $37,435.	W. H. Watters, Bayonne, N. J., $40,460.	Rebill & Norton, Jersey City, N. J., $41,601.	Engineer's estimate
24-in., 10 to 12 ft. deep, 10 ft	$2.65	$1.30	$1.47	$1.26	$1.19	$1.00	$1.67	$1.65	$1.80	$2.50	$2.00	$1.61	$1.70	$1.50	$2.00	$1.75	$2.25	$1.30	$1.06	$2.25	$2.20	$2.75	$1.95	$2.00	1.72
18 " 8 " 10 " " 647 ft	.80	.86	.77	.75	.75	.74	.90	1.12	.94	.95	1.00	1.10	.93	1.19	1.32	1.25	1.20	1.15	1.27	1.50	1.60	1.45	1.40	1.55	1.00
18 " 10 " 12 " " 1,807 "	.90	.88	.85	.82	.81	.80	1.00	1.12	1.04	1.15	1.15	1.15	.98	1.31	1.32	1.35	1.30	1.15	1.37	1.75	1.65	1.65	1.60	0.55	1.18
18 " 12 " 14 " " 1,325 "	1.10	1.03	.95	.96	.87	1.04	1.10	1.12	1.15	1.48	1.50	1 24	1.08	1.43	1.32	1.45	1.40	1.20	1.47	2.00	1.70	1.85	1.90	1.55	1.51
15 " 0 " 8 " " 751 "	.54	.56	.60	.55	.50	.55	.68	.73	.58	.59	.80	.86	.67	.75	1.00	.88	.90	.90	.85	1.30	1.35	1.50	1.20	1 47	.70
15 " 8 " 10 " " 2,887 "	.60	.61	.65	.62	.65	.75	.74	.73	.78	.78	.90	.88	.72	1.00	1.05	.98	1.00	1.00	1.10	1.50	1.40	1.35	1.30	1.47	.81
15 " 10 " 12 " " 1,603 "	.70	.73	.70	.69	.69	.88	.83	.73	.94	1.02	1.00	91	.90	1.20	1.15	1.08	1.20	1.05	1.20	1.70	1.45	1.50	1.50	1.47	1.04
15 " 12 " 14 " " 890 "	.93	.85	.85	.83	.75	1.00	1.00	.73	1.04	1.23	1.25	.99	92	1.33	1.17	1.18	1.25	1.15	1.30	2.00	1.50	1.65	1.80	1.47	1.39
12 " 0 " 8 " " 1,698 "	.45	.48	.48	.48	.49	.67	.50	.63	.50	.50	.65	170	.52	.60	.80	.72	.80	.80	.69	.95	1.20	1.10	1.10	1.37	.56
12 " 8 " 10 " " 1,761 "	.50	.56	.56	.55	.53	.70	.64	.65	.62	.60	.70	.72	.65	.81	.83	.82	.90	.90	.94	1.05	1.25	1.20	1.25	1 37	.67
12 " 10 " 12 " " 2,400 "	.55	.66	.64	.65	.57	.75	.74	.63	.83	.82	.70	.74	.75	1.03	.85	.92	1.00	1.00	2.2a	1.25	1.30	1.30	1.40	1.37	83
12 " 12 " 14 " " 715 "	.70	.76	.75	.76	.62	.90	.89	.63	1.00	1.00	1.00	.79	.85	1.25	.90	1.02	1.20	.75	1.14	1.65	1.35	1.45	1.70	1.37	1.09
10 " 8 " 10 " " 437 "	.45	.45	.56	.51	.43	.60	.54	.53	.49	.51	.60	.62	.52	.80	.65	.69	.80	.85	.84	.80	.95	1.15	1.15	1.29	.62
10 " 10 " 12 " " 658 "	.50	.54	.64	.58	.51	.68	.64	.53	.53	.66	.65	.65	.58	1.00	.69	.79	.90	.70	.94	.85	1.00	1.28	1.50	1.29	.72
8 " 0 " 8 " " 8,130 "	.28	.42	.40	.39	.35	.35	.40	.43	.28	.36	.40	.49	.43	.50	.53	.40	.45	.75	.44	.60	.65	.65	1.00	1.20	.43
8 " 8 " 10 " " 1,260 "	.35	.48	.47	.46	.44	.45	.50	.43	.45	.45	.60	.51	.50	.75	.55	.50	.85	.80	.69	.69	.70	.80	1.10	1.20	.51
8 " 10 " 12 " " 580 "	.40	.56	.55	.53	.45	.50	.59	.43	.58	.60	.60	.56	.55	.95	.60	.60	.90	.79	.75	.75	.75	.95	1.30	1.20	.64
Manholes, 4 × 5 ft., 0 to 10 " deep, 25.	40.00	28.00	32.00	44 67	45.00	35.00	33.00	30.00	42.50	34.00	30.00	36.00	37.50	35.00	25.00	45.00	30.00	40.00	60.00	35.00	40.00	55.00	33.00	28.00	45.00
" 4 × 5 " 10 " 12 " " 15.	42.00	31.00	35.00	47.00	50.00	37.50	35.00	30.00	46.75	36.00	38.00	38.00	40 00	39.00	26.50	50.00	30.00	50.00	70.00	38.00	45.00	80.00	35.00	32.00	48.00
" 4 × 5 " 12 " 14 " " 9.	46.00	33.00	37.00	50.00	55.00	42.50	37.00	30.00	51.00	38.00	40.00	70.00	42.00	40.00	28.00	10.00	30.00	60.00	80.00	45.00	50.00	90.00	36.00	35.00	65.00
" 3 × 5 " 0 " 8 " " 12.	25.00	24.00	27.00	33.00	35.00	35.00	30.00	25.00	39.25	29 00	25.00	28.00	28.00	24.00	20.00	40.00	30.00	40.00	40.00	30.00	35.00	62.00	30.00	25.00	40.00
" 3 × 5 " 8 " 10 " " 6.	30.00	26.00	30.00	36,00	40.00	38.00	32.00	25.00	43.50	32.00	30.00	31.00	30.00	30.00	22.00	45.00	30.00	50.00	50.00	35.00	40.00	68.00	30.00	27 00	45.00
15-in. drop connections at manholes, 1	2.50	1.50	5.00	3.07	5.60	4.00	15.00	15.00	6.00	2.50	2.00	10.00	5.00	5.00	22.50	10.00	15.00	8.00	8.00	6.00	3.50	4.85	10.00	8.50	5.00
8 " " " " " 23.	1.25	.90	3.00	1.09	3.25	3.00	3.00	10.00	1.95	1.75	2.00	3.00	2.50	3.00	22.50	10.00	5.00	8.00	4.00	3.00	1.75	3.85	5.00	3.00	2.50
Lampholes 25	6.75	2.00	5.50	6.39	9.00	8.50	7.50	10.00	8.00	12.00	10.00	4.75	10.00	7.00	6.00	10.00	10.00	20.00	8.00	10.00	20.00	8.50	6.00	9.00	6.00
150-gallon flush tanks, 2	90.00	85.00	75.00	58.00	75.00	80.00	70.00	75.00	70.00	90.00	125.00	70.00	90.00	85.00	200.00	100.00	100.00	125.00	300.00	75.00	80.00	60.00	95.00	55.00	70.00
1,000 gallon flush tanks, 1	125.00	130 00	125.00	175.00	125.00	115.00	150.00	125.00	145.00	175.00	300.00	208.00	300.00	170.00	500.00	225.00	400.00	160.00	700.00	150.00	400.00	185.00	225.00	160.00	200.00
Y branches on 18-in. sewer, 130	1.00	1.00	.95	1.10	1.37	1.15	1.00	1.10	1.20	1.25	1.15	1.00	1.10	1.00	2.00	1.75	2.30	.70	1.50	1.25	1.75	1.45	2.00	1.08	1.30
" " " 15 " " 180	.75	.78	.70	.81	1.00	.85	.78	.75	.90	1.00	.50	.74	.80	.80	1.50	1.38	1.70	.60	1.15	.95	1.45	1.05	1.50	.78	.95
" " " 12 " " 270	.40	.55	.50	.56	1.00	.60	.55	.60	.60	.75	.45	.51	.55	.60	.90	1.12	1.15	.60	.95	.70	1.00	.75	1.10	.60	.65
" " " 10 " " 60	.38	.42	.45	.44	.75	.50	.42	.50	.50	.60	.50	.42	.42	.45	.70	1.00	1.00	.55	.70	.55	.90	.55	1.00	.42	.50
" " " 8 " " 320	.27	.33	.30	.29	.75	.35	.30	.48	.32	.45	.30	.29	.30	.35	.50	.55	.60	.55	.50	.45	.85	.40	.65	.27	.35
Extension connections on Y's, 300	1.25	.80	.75	.40	2.10	1.00	.75	3.00	1.40	.40	2.00	1.98	1.50	1.00	3.00	.90	2.00	3.50	2.00	1.25	1.50	1.60	.50	.90	1.30
3-in. underdrains, 3,000	.06½	.10	.10	.08	.05	.10	.12	.10	.08	.20	.13	.12	.60	.15	.07	.30	.30	.30	.25	.10	.50	.20	.20	.20	.05
4 " " 2,000	.07	.12	.10	.10	.07	.15	.10	.12	.10	.25	.15	.16	.60	.15	.08	.30	.35	.35	.30	.12	.22	.25	.25	.25	.08
6 " "	.15	.15	.10	.14	.11	.75	.60	.15	.19	.30	.20	.22	.60	.15	.10	.35	.40	.40	.45	.15	.30	.30	.38	.38	.10

BELGIAN BLOCKS.—Norfolk, Va.—The city has contracted with the Mount Airy Granite Co. for 3,000 tons of Belgian blocks, at $4.25 per ton, and with the Lineham Granite Co. for 1,000 tons, at $4.20 per ton.

WATER-WORKS.—Christiana, Pa.—Allan A. Herr, Engr., Lancaster, writes us that the following bids were received for constructing the plant of the Christiana Gravity Water Co., as noted Aug. 16: Kay & Coon, Bellwood, 4 and 6-in. terra-cotta pipe, laid, 9 and 13 cts.; reservoir, $520; 6, 8 and 4-in. cast iron pipe, laid, 48, 62 and 38½ cts.; 8, 6 and 4-in. gate valves, $20.50, $14.90 and $10.50; hydrants, $21.50. Chas. F. Stauffer, Philadelphia, bid 16 cts., 18 cts., $1,120, 65 cts., 77 cts., 48 cts., $23, $18, $13 and $31, respectively; Frank Hinden, Lancaster, ——, 24 cts., $585, 48 cts., 65 cts., 37 cts., $19, $14, $14.50 and $25; John B. Foley, Philadelphia, 15 cts., 17 cts., $994, 47.82 cts., 65⅝ cts., 34¼ cts., $20.25, $13.75, $9.75 and $21.75.

son, at 18½ cts.; and F. Kordsiemon, at 27½ cts.; furnishing and setting sandstone curbing, J. F. Collins, at 35 cts. per lin. ft. for new curbing and 6 cts. for resetting old curbing. The bids rejected ranged from $1.11 to $1.30 per sq. yd. for paving and from 39 to 43 cts. per lin. ft. for curbing. The bid accepted for furnishing brick was at $9 per M. and the Purington Paving Brick Co. bid $9.50, or 63.65 cts. per sq. yd.

Jacksonville, Fla.—The lowest bid received last week for 75,000 sq. yds. of paving brick was that of the Coulsale Brick & Tile Co., at 94 cts. per sq. yd., the delivery of brick to be completed by July 1. This is the same brick now being used in paving Main St. Other bids ranged from 98 cts. to $1.70 per sq. yd.

PIPE.—Fort Dodge, Ia.—The council has contracted with the Howard-Harrison Co. for 3,700 ft. of 10-in. cast iron water pipe at $21.40 per ton, f. o. b. cars at Fort Dodge. The pipe will be laid by Riley & Hurley.

MACADAMIZING.—Wheeling, W. Va.—Contracts for macadamizing the national road have been awarded to Wesley Bowman, Joseph Meyer, William Folmer, Sr., Thornburg Bros., J. M. Thornburg, W. H. Springer, W. T. Crummie, Martin White, James Mills, Martin Bowman, and John D. Hanna, at prices ranging from 79 cts. to $1.17 per cu. yd.

ELECTRIC LIGHTING.—Portland, Ore.—The only bid received Sept. 1 for 605 arc lights of 2,000 c. p. and 710 incandescent lights of 25 c. p. for two years from April 1, 1895, was that of the Portland General Electric Co., at $9, $8.75, $8.50 and $8.25 per month per arc light for each 6 mos., and $1.90, $1.80, $1.70 and $1.60 for incandescent lights; additional lights at $8 and $1.50. This company is said to have the largest long-distance supplying plant in the world and has lighted the streets of this city for about 10 years, the first contract being at $25 per month for each arc light.

WATER TOWER.—Marlboro, Mass.—The following bids were received for the proposed water tower for the high service, tower to be 51 ft. in diameter at bottom, 30 ft. at top and 75 ft. high, and tank 30 ft. in diameter and 35 ft. high; Cy. Engr., B. R. Felton:

	With roof.	Without roof.
*Tippett & Wood, Phillipsburg, N. J.	$8,960	$7,959
Riter & Conley, Pittsburg, Pa.	9,974	8,884
Berlin Iron Bridge Co., E. Berlin, Conn.	12,290	10,840
Groton Iron Wks., Fitchburg, Mass.	9,985	9,400
Boston Bridge Wks., Boston, Mass.	10,898	9,241
Hawkins Iron Wks., Springfield, Mass.	11,705	10,995

*Contract awarded to Tippett & Wood for tower with roof.

SEWERS.—Charlottesville, Va.—The contract for the sewers recently advertised has been awarded to Vaughn & Luck, at $45,621. A previous contract was awarded to the same bidders and the itemized bids published Aug. 9. N. Wilson Davis, Engr. in Charge, writes us that the bids received Aug. 30 were as follows:

Bids Received at Charlottesville, Va., Aug. 30, for Constructing Sewers.

	Pipe sewers, per lin. ft.—				Con-			
	18-in.	16-in.	15-in.	12-in.	10-in.	8-in.	Brick.	crete.	Rock.	Total.
Kay & Coon, Bellwood, Pa	$0.67¾	$0.60½	$0.52½	$0.43½	$0.35	$0.29¼	$12.00	$3.00	$1.18	$53,425
J. C. Carpenter, Clifton Forge, Va.	.55	.55	.50	.45	.40	.30	9.00	2.00	.90	49,775
Va. Pvg. & Const'n Co., Lynchburg	.70	.40	.40	.33	.28	.25	11.00	3.50	2.50	49,498
Guild & White, Chattanooga, Tenn.	.60	.50	.50	.40	.36	.30	11.00	3.50	1.50	48,574
Lane Bros., Esmont, Va.	.67	.55	.53	.38	.33	.29	11.50	4.00	1.00	48,214
A. H. Gentry, Charlottesville, Va.	.61½	.50.6	.49.9	.36.2	.30.4	.25.9	11.00	2.74	1.23	46,840
A. C. Maynard & Co., Richmond, Va.	.58½	.54	.50	.38	.33	.29	9.00	1.00	.75	46,730
Vaughn & Luck, Roanoke, Va.	.55	.51	.45	.34	.29	.28	9.00	3.00	1.00	45,620

Chester, Pa.—James B. Campbell, Cy. Clk., writes us that contracts have been awarded as follows: To J. B. Helms, Chester, Pa., 24-in. brick sewers in 14th and 5th Sts., at $1.37 and $1.33 per lin. ft.; inlets, $60; manholes, $18; rock excavation, $2 per cu. yd.; slants, 25 cts. each, and an 18-in. terra-cotta pipe sewer in Mary St. at $1.05 per lin. ft.; inlets, $60; manholes, $15; rock excavation, $2. To W. E. Riley, Chester, 18-in. terra-cotta pipe sewer in Pennell St., at 98½ cts. per lin. ft.; inlets, $50; manholes, $22; house connections or slants, $1.25; rock excavation, $3.

WATER-WORKS.—Hamilton, N. Y.—Bids were opened Sept. 6 for constructing a system of water-works; Engrs., The Stanwix Engineering Co., Rome, N. Y. The bids for a 200,000-gallon steel or iron tank were: The Rome Locomotive & Machine Wks., Rome, at $2,390, and the Groton Bridge & Mfg. Co., Groton, N. Y., at $2,290. For pumping station, stack, well and tower building, the bids were: W. T. O'Connor & Co., Syracuse, $13,177 (including the 200,000-gallon tank); Pius Kerner, Utica, $15,322, and W. J. Jones, Rome, $12,000. For intake, tile, filter and piping system the bids were as follows:

Flood & Sherrill, Sandy Hill, N. Y.		$32,137
John Marsden, Utica		32,330
Otis & Longyear, Kingston		33,840
J. S. Bull, Cortland		34,450
Wm. T. O'Connor, Syracuse		35,909
Troy Public Wks. Co., Troy		36,500
M. Sullivan, Little Falls,		37,339
M. B. Birdseye, Fayetteville		39,578

The pumping plant will include a 750,000-gallon high-duty pumping engine, a 750,000-gallon low-duty pumping engine, and two 50-HP. boilers, with all connections and accessories. The bids for this were as follows:

	Style of h.d. engine.	Duty. mil.gal.	Total bid.
A. J. L. Loretz, Brooklyn	Cross compd. flywheel.	110	$9,500
Snow Stm. Pmp. Wks., Buffalo	Cross compd. flywheel.	90	10,100
" " " " "	Triple exp'n.	70	7,700
F. R. Dravo & Co., Pittsburg	Hor., flywhl. Corliss.	60	6,500
H.R. Worthington, New York	Triple exp'n.	70	5,695
" " " " "	Comp. cond.	40	4,450
J. S. Bull, Cortland	Triple exp'n.	70	4,998
" " " "	Comp. cond.	40	3,998

PIPE.—Joliet, Ill. O. R. Rauchfuss, Cy. Engr., writes us that the following bids were received last week for 500 tons of 14-in. and 35 tons of 12-in. cast iron water pipe, (1) being the price per ton delivered f. o. b. cars Joliet, and (2) delivered at work:

	—Pipe.—		—Specials.—	
	1.	2.	1.	2.
C. E. Woodruff	$19.35	.....	$45	.....
C. W. Harrison	19.45	.....	45	.....
S. L. Whistler	19.10	$19.45	50	$52.50
Addyston Pipe Co.	19.33	19.73	50	52.50

DRAINAGE WORK.—St. Paul, Minn.—Ezra G. Valentine, Pres. Red River Valley Drainage Comn., has sent us the following statement of the bids received Sept. 1 for constructing three ditches, 20 ft. wide at the bottom, 35 ft. at the top, and 4 ft. deep, and which are expected to reclaim 250,000 acres of swamp land, now worthless. The bids are given per cu. yd. and were as follows, (1) being for the Snake River ditch, 2½ to 3 miles in length, (2) Wild Rice River ditch in Norman county, and (3) Wild Rice River ditch through the Borup Swamp, 5 to 6 miles in length:

	1.	2.	3.
Larson P. Gunderson	.....	$.10	.....
McKinnon Bros., Crookston (for all $.11½)	$.10	.09	$.15
C. Enelx	*.09¾	.....	.....
John Grant, Faribault	.12½	.12½	.12½
L. R. Larkin	.1084	.0985	.1398
Henry O'Neill	.11	.09	.11
A. C. Rheinhart (for all $.11¾)	.11¾	.11¾	.14
James Kennedy	.13	.10	.13
James Nolan	.10	*.08	*.10
Chas. E. Joy & Co., St. Paul	.13	.10¼	.13½
Henry Swanson, St. Paul	.....	.....	.11
M. R. Brown	.12	.09	.....
M. C. Burke, West Superior	.10¾	.08¾	.10¾
Kirkland & Starkey, St. Paul	.1147	.1147	.1147
T. Smith, Crookston	.11¼	.09¾	.18
Foley Bros. & Guthrie, St. Paul	.10⅝	.10⅝	.10⅝

*Awarded contracts.

INDUSTRIAL NOTES.

THE STANDARD SHEET ASPHALT CO. has secured a site for its plant at Bridgeport, Conn.

THE HASKELL & BARKER CO., of Michigan City, Ind., has an order for 500 freight cars for the Illinois Central R. R.

THE SHAW ELECTRIC CRANE CO., of Muskegon, Mich., is shipping a 67-ton crane to the United States arsenal at West Troy, N. Y. Orders have been received recently for a 20-ton crane for Vienna, Austria; a 2-ton crane for the Nekoosa Paper Co., Nekoosa, Wis., and 5, 10 and 40-ton electric travelling cranes for the St. Louis Stamping Co., St. Louis, Mo.

THE BROOKS LOCOMOTIVE WORKS, Dunkirk, N. Y., are shipping to Brazil ten locomotives of the mastodon type, with cylinders 21 × 26 ins. The boilers are of the Belpaire type, 5 ft. 8 ins. diameter. The same works are also building ten suburban engines for Brazil. All the engines are for the Central Railway (formerly the Dom Pedro Segundo Railway).

NEW COMPANIES.—Venice Land & Phosphate Co., Chicago, Ill.; $300,000; James Reid, Fred T. Bunker and John A. Cooper.——Cascades Improvement & Transportation Co., San Francisco, Cal.; $50,000, with $5 paid up; Chas. W. Kohlsaat, E. G. Kelton and M. J. Waldheimer.——Oak Tree Quartz Mining Co., Grass Valley, Cal.; $100,000, all paid in; Patrick Brock and Thos. F. Brock.——Phoenix Telephone Co., New York; $5,000,000, with $500 paid in; Edwin L. Louder, Mount Vernon, N. Y.; George B. Inman, Danvers, Mass.——Automatic Street Sweeper Co., Chicago, Ill.; $100,000; Adelbert Hamilton, M. J. Stevenson and A. Q. Reynolds.——Russian-American Mfg. Co., New York, N. Y.; $100,000, with $1,000 paid in; Charles A. Benedict, Darien, Conn.; N. P. Howell, Newark, N. J.——Delaware Foundry Co., Burlington, N. J.; $20,000, with $1,200 paid in; D. Snowden Haines and W. E. McNeal.——Canda Cattle Car Co.; $5,000,000; S. Goodridge, New York; W. S. Fielding, South Orange, N. J.

MUNICIPAL BOND MARKET.

New York, Sept. 11, 1894.

The feature of the financial week has been the sudden increase noted in bond sales, and municipal bonds have figured to no small extent in the impetus that has been given to the market for investment securities. The recent strength and activity is due to many natural causes. Prior to August there was a strong investment demand for first-class securities like municipal issues, but with the elimination of the tariff uncertainty that prevailed during August, many capitalists have come into the market and have greatly augmented the demand for investment issues.

Naturally municipal bond dealers are much encouraged by the turn the bond market has taken. They note that September is generally a good month for business, but the demand this year is unexceptionally good and compares advantageously with the business done a month ago. Big as have been some of the purchases made by leading dealers just in anticipation of such a rush of orders, it is feared by many of the prominent bond houses that at the present rate of disposal they will soon run short of desirable municipal bond issues. To make the matter worse, there are not enough new issues in sight to replenish, but this will soon be remedied, as any number of bonds that have been withheld by the financial officers of various municipalities will now be offered to the public.

Prices are even a trifle higher now than the stiff figures that have ruled for months past, and, with the many unfilled orders on hand, even better figures may be anticipated. The outlook, therefore, is for an unusually busy month, and dealers are straining every nerve to prepare for it.

Some lively bidding may, therefore, be awaited at the forthcoming sales by cities. Jersey City wishes to borrow $400,000 on a 4½ per cent. basis; San Antonio, Tex., has $500,000 5 per cent. bonds for sale; New Brunswick, N. J., wishes to dispose of $100,000 refunding bonds. These are all the prominent offerings in sight, though there is a lot of smaller issues that will be eagerly picked up. The most prominent sale of recent days has been the disposal by New Orleans, La., to the Louisiana State National Bank of $4,500,000 of its new refunding 4 per cent. bonds on a 3½ per cent. commission. As furnishing to contractors and other interested parties an index as to the credit of cities and towns, the following quotations of current offerings are appended:

MUNICIPAL BONDS.

	Price.
County of Flathead, Mont., Gold 6s	107⅝
City of Bartow, Fla., 20-year 6s	102
City of Paris, Ill., Water 6s	105½
City of Bethany, Mo., Gold 6s	105¾
County of Park, Mont., Gold 6s	109¼
City of Moscow, Idaho, Gold 6s	102¾
City of Pullman, Wash., Gold 6s	103¾
City of St. James, Minn., 6s	107½
School District of Brainerd, Minn., 6s	108¾
County of Brazoria, Tex., 6s	103½
County of Taos, N. M., 6s	101
School District No. 6, Kings Co., 6s	107¼
City of Harriman, Tenn., 6s	102
City of Toledo, O., 5s	111⅝
City of Omaha, Neb., 5s	111
City of Portland, Ore., Gold 5s	112½
City of Galveston, Tex., 5s	101½
County of Vanderburgh, Ind., 5s	109½
City of Cheboygan Mich., 5s	104
City of Ogden, Utah, 5s	103½
City of Parkersburg, W. Va., 5s	103½
City of Brooklyn, N. Y., 4s	110½
City of Marlboro, Mass., 4s	107
Town of Methuen, Mass, 4s	107
City of Waterbury, Conn., 4s	105½
City of Chicago, Ill., Gold 4s	104¼
City of Chicago, Drainage 5s, 1895	104¾
" " " 5s, 1905	104¾
" " " 5s, 1910	106½
" " " 5s, 1914	107½
City of Denver, Colo., Public Impvt 4s	100
Hamilton, O., 4½s	100.51
East Liverpool, O., 5s, 20-30 years	106.06
Belknap, 20-year, 4s	103.06
District of Columbia, 3.65s	113.406

RAILWAY STOCK MARKET.

New York, Sept. 11, 1894.

General speculation in the railway stock market has been absolutely dead of recent days. As evidence of the truth of this remark it may be noted that, excepting St. Paul and Burlington, there was not another stock in which the transactions during the five days ending Saturday last amounted to 30,000 shares, a figure easily reached on any one active stock on any single day. The lack of activity has not been attended by any falling off in prices, though periodical raids have been made, with little, however, resulting to the profit of the bears.

Expectations of a bad showing in the government report on the corn crop has been the main basis of these attacks. The actual figures, as published yesterday, indicate that a very much reduced corn crop must be looked for, but the damage is not as severe as has been generally estimated, and trustworthy reports have it that even since the compilation of the official figures a decided improvement has been shown in the condition of the corn crop. Then the Southern States will produce this year an unusually large crop, and they will have a large surplus to send into the districts that themselves generally do an export business.

What has held prices of railway stocks up so well despite the lack of public interest in their course has been the generally accepted belief that the maintenance of such dividend rates as are in present existence will continue to be paid. One or two companies take action this week, and Wall Street feels confident that current dividend rates will be well adhered to. The publication of the annual report of the Chicago, Milwaukee & St. Paul Railway Company is another factor that has been of great influence in restoring confidence in railway stocks. It must have a particularly happy effect abroad, in that it shows the ability of American railways, under conservative management, to make money even in hard times. The St. Paul report shows that, in spite of times that were phenomenally bad, the railway earned a surplus—small, it is true, but nevertheless a surplus—over and above all operating expenses, taxes, interest payments and dividends. A railway able to do this last year can hold its own at any time, and its stock is worth buying.

Wheat, too, must greatly aid any efforts to bring about a prolonged bull movement in the progress now surely and steadily being made in the various railway organization schemes before the financial public. All the Northern Pacific branch roads have now been lumped under one receiver, thus vastly simplifying the work of rehabilitation. Then the practical completion of the New York & New England Railway Company is assured in the granting yesterday of the decree of foreclosure by the United States Court. Then the prominent factions in the Philadelphia & Reading Railway Company are arranging for an amicable readjustment of their differences, and this great property will soon be in a fair way of reconstruction. The success of the Richmond Terminal rehabilitation has lent a great impetus to these various schemes, and the coming of better times will make their carrying out an easy operation.

RAILWAY STOCK MARKET.

Railway stocks	Closing prices Sept. 11.
Alton & Terre Haute	30
Atchison, Topeka & Santa Fe	7⅝
Baltimore & Ohio	78½
Canada Southern	52¼
Chesapeake & Ohio	20½
Chicago, Burlington & Quincy	76¼
Caicago & Northwestern	105¾
Chicago, Milwaukee & St. Paul	66¼
Chicago, Rock Island & Pacific	65¾
Cleveland, Cincinnati, Chicago & St. Louis	40
Delaware, Lackawanna & Western	168½
Delaware & Hudson	134½
Hocking Valley	19
Illinois Central	94½
Lake Shore & Michigan Southern	136¼
Louisville & Nashville	56¾
Missouri Pacific	30¾
Missouri, Kansas & Texas	15¾
Mobile & Ohio	20¾
New Jersey Central	114½
New York Central	101½
New York & New England, 3d asst. pd.	27⅝
New York, New Haven & Hartford	181
New York, Chicago & St. Louis, 1st pfd.	65
New York, Lake Erie & Western	16
New York, Ontario & Western	17⅝
New York, Susquehanna & Western	16⅝
Northern Pacific	5¾
Northern Pacific, pfd.	21½
Philadelphia & Reading	21½
Richmond Terminal	19½
St. Paul & Omaha	38
Southern Pacific	21
Texas Pacific	10¾
Union Pacific	14
Wabash pfd.	16½
Wheeling & Lake Erie	12¾

BOSTON RAILWAY STOCKS.

	Sept. 11.
Boston & Albany	206½
Boston & Maine	150½
Fitchburg, pfd.	74½
Old Colony	180

PHILADELPHIA RAILWAY STOCKS.

	Sept. 11.
Lehigh Valley	39¾
Pennsylvania Railroad	51¾